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LIGHT METALS MONOPOLY

BY

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PREFACE

OFFICIAL court records in cases presented by the Anti-Trust Division of the Department of Justice for the last decade provide economists with rich materials for study of individual monopolies and industrial combinations. The aluminum anti-trust suit, which was filed in 1937 and ended in 1945 with the appellate decision that the Aluminum Company of America was an illegal monopoly, seemed particularly attractive for several reasons. Aluminum control is doubly important for citizen consumers, as the light metal is useful in peace and in war. As aluminum production is integrated, based on laboratory research and dependent on electricity, it exemplifies trends in twentieth century production which deeply influence industrial organization. Also, aluminum production in the United States is associated with one of the leading financial-industrial family blocs in American life, the Mellons.

The case records reviewed in a comprehensive manner the principal aspects of Alcoa's industrial history, and provided an opportunity to find out just how a national monopoly arises. My treatment has emphasized three factors useful to aluminum monopoly: control of power, international cartel relations, and control of a substitute light metal, magnesium. Facts about magnesium control were garnered from the records in another and more recent anti-trust investigation, which ended in a consent decree in 1942. I have also attempted to show how the requirements of our war economy affected the monopoly situation, and how the meeting of war needs was in turn influenced by it. In the final chapter, I have examined the relation of government policy to the building of monopoly power, and have suggested certain policy alternatives to cope with the basic economic problem of monopoly; in this chapter may be found (on pp. 241-9) a review of the court history of the 1937 case.

This work was not intended to include a detailed picture of the operating performance of the aluminum industry. The job of compiling the history of prices, production, investment, and marketing policies of the world industry through the mid-1930's had already been done by Donald H. Wallace in his basic study, *Market Control in the Aluminum Industry* (Cambridge, 1937), to which numerous references are made in this study. Much of Wallace's material on the United States has been brought up to date in a fairly recent factual compendium, *Aluminum—An Industrial Marketing Appraisal,* by N. Engle, H. E. Gregory, and R. Mossé (Seattle, 1944).

I am deeply indebted to Professor James C. Bonbright for his guidance and patience during the execution of this study, and to Professors Robert Murray Haig, Thomas T. Read, John Maurice Clark, and Mr. Irving Lipkowitz for reading the manuscript and making helpful criticisms. Mr. Alexander Stevenson kindly allowed me to read his unpublished manuscript on magnesium before the last revision of my presentation, and I owe several interpretations to him. Miss Rose Boots and the staff of the School of Business Library at Columbia University were of great assistance in making materials available; I thank the Departments of Justice and Commerce for similar kindness. My sister, Grace Mildred Feldman, typed parts of the manuscript efficiently and with ingenuity, and my husband contributed unsparingly his moral support.

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CHAPTER I

THE MARKET FOR LIGHT METALS

Economists have recognized the growing power of large scale enterprises over production, prices, and investment, as the trend towards industrial concentration has proceeded in this century. While 100% monopolies " in the crude sense of single sellers of products for which there are no nearby substitutes are extremely rare," [1] the tendency for sellers of important products to grow fewer in number, and more powerful in the market, and to combine into groups which eliminate competition among them, is recognized as a basic social and economic problem.

The modern tendency towards greater specialization of production and differentiation of commodities through advertising and variations in quality has narrowed some commodity markets, and has introduced into some industries powers of market control identified with monopoly. At the same time, it has increased inter-product competition in such fields as foods, textiles, and metals.

If a product with no near substitutes controlled by one seller serves a common use, or a combination of uses, or a use essential to the public interest, the power of the monopolist is felt broadly or with special force. By these standards, monopoly control of light metals (aluminum and magnesium) is a significant problem. Aluminum and magnesium are more distinguished by the part they play in the construction of military aircraft, and by their usefulness wherever light weight is of service, than they are by their quantitative prominence in American industrial production and consumption. The 1944 aluminum capacity of the United States was only 1,050,000 tons and the magnesium capacity only 240,000 tons—both representing a small fraction of the estimated steel capacity in the same year (over 90,000,000 tons).[2]

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[1] Arthur Robert Burns, *The Decline of Competition, A Study of the Evolution of American Industry*, New York, 1936, p. 3.

It is possible that, in the absence of monopoly power over output and investment, the controlled commodities would have been produced in greater quantity, although still on a far smaller scale than such a product as steel. The potential importance of light metals may be inferred from a comparison of uses of aluminum and magnesium with uses now served by other materials. Although inter-product substitution is imperfect because of differing chemical and physical properties, technology has partly overcome those natural inferiorities of light metals which retard substitution. Some conclusions are reached in this chapter as to the extent and elasticity, or price-sensitivity, of the demand for light metals considered as a group, and for magnesium considered as a substitute for aluminum.

IS ALUMINUM A MONOPOLY?

In its defense against a Federal suit for violation of the Sherman Anti-Trust Act, filed in 1937, the Aluminum Company of America (Alcoa), sole producer until 1940 of virgin aluminum metal in the United States, claimed that it was not a monopoly. It argued that its raw product may be replaced by and is competitive with scrap aluminum, imported aluminum, zinc, lead, copper, steel, tin, glass, and even paper.[3]

The Department of Justice, however, took the view that only if another material were fully interchangeable with aluminum in its entire range of uses would it be a perfect or complete substitute. Such a definition stresses the unique physical properties of the element aluminum, but does not rule out the possibility of active competition by imperfect substitutes. For many uses of aluminum some substitute exists and is in fact employed in greater or less amount.

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[2] *New York Times*, November 10, 1944.

[3] Equity No. 85-73, In the District Court of the United States for the Southern District of New York, United States of America v. Aluminum Company of America, et al. Brief of Aluminum Company et al., p. 199.

The courts, in enforcing the Sherman Anti-Trust Act, have focussed on overt acts to exclude competition, and on combinations in restraint of trade, rather than on the mere existence of monopoly power over markets. Until the Alcoa case, no anti-trust case involving 100% control of a major unpatented article had come before the courts. Because of this fact, no previous decision was found " squarely ruling upon the narrow question as to whether an enterprise producing 100% of the product in a large industry constitutes a monopolization *per se* in violation of Section 2 of the Sherman Act." The Government contended that the Act did forbid such product control, when read in a manner consistent with the underlying purpose of the legislation, and its interpretation was upheld by the final appeals court. The Government said that Alcoa possessed monopoly power through its 100% control of American production of aluminum ingot, and that it exercised its power so as to control prices, to reap monopoly profits, and to restrain the use of aluminum in industry.[4] To prove that a monopoly existed, the Government had to establish that virgin aluminum was a distinct commodity in spite of the competition of other materials. The Government laid stress on Alcoa's ability to fix the price of aluminum. If the price is raised above some critical point, the volume of aluminum sales will fall off, since imperfect substitutes exist. But they merely limit Alcoa's power, and only in so far as they are cheap and acceptable substitutes in certain uses. They do not imply that Alcoa does not have power to determine what aluminum prices shall be. (This point was accepted by the appeals court.)

WORKABLE COMPETITION

However, Professor J. M. Clark lays stress on the role of inter-product competition, enlivened by the creations of modern science, in reducing monopoly power. In the long run, says

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[4] The Government also asserted that Alcoa's monopoly was illegally acquired and maintained by acts of exclusion, discrimination, cartel associations, etc. Equity No. 85-73, Brief for the United States, December 2, 1940, p. 38.

Clark, more general and closer substitution may be relied on to bring many large scale industries into the ranks of " fairly healthy and workable imperfect competition." [5] This would become applicable to aluminum as processes using new raw materials to make aluminum, and substitute products such as magnesium, become important. (Alcoa, however, was able to hold back magnesium production. See Chapter VIII). Clark also describes how monopolistic price and output policy may be moderated by fear of potential competition.[6] But, in the aluminum industry, the "moderation" of price policy has sometimes taken the form of charging higher prices in the most protected markets.

Clark's definition of competition emphasizes the effective limitation on prices imposed by " the free option of the buyers to buy from a rival seller or sellers of what we think of as 'the same' product." [7] Different properties of indirect substitutes, as will be shown below, make it difficult to claim that aluminum, in certain important uses, is " the same " as substitutes in usefulness to consumers. Where " sameness " does exist, aluminum is in active competition (for example, with copper cables) or the substitute has been controlled by agreement of the sellers (as in magnesium). Furthermore, as virgin aluminum is sold to fabricators whose equipment is especially adapted to the working of aluminum rather than to other materials, the fact that end products made of substitute materials may compete with aluminum products does not free the fabricators from dependence on the aluminum monopoly during the life of their equipment.[8]

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[5] J. M. Clark, " Towards a Concept of Workable Competition ", *American Economic Review*, vol. XXX, no. 2, pt. 1, June, 1940, p. 256. Clark says that a purely competitive market (in which the price was no higher than the cost of the last added output made by existing plants) would expose firms to operating deficits when demand fell below capacity. This would bankrupt most industries. A degree of inelasticity in demand (identified by some other writers with monopoly power) is needed to make competition workable, by allowing leeway for a flexible price policy to cope with booms and depressions. *Ibid.*, p. 250.

[6] *Ibid.*, p. 247.

[7] *Ibid.*, p. 243.

UNIQUE QUALITIES OF ALUMINUM

Each of the materials named by Alcoa as competitive with aluminum shares with it one or more properties, lacks certain others. The superiority of aluminum for certain uses rests on its combination of properties. Silvery-white, aluminum is an excellent reflector of light and heat, and can be permanently coated to prevent tarnishing, so that the metal keeps its reflective quality and presents any desired color.

Aluminum, with a specific gravity of 2.70, is one of the lightest metals; it is 2/7 as heavy as copper, ⅓ as heavy as steel. Although soft and lacking in tensile strength when pure, it lends itself to alloying and tempering to lessen these disadvantages, and thus becomes available for structural uses. Commercially pure aluminum will support a load up to 13,000 pounds per square inch in tension before breaking. By cold working, alloying, and heat treating, this point may be raised to 70,000 ℔.[9]

The electrical conductivity of aluminum is only 61% of that of an equal bulk of copper, but its superior lightness makes it a close competitor in high-tension electrical transmission lines if the price of aluminum is less than 2.1 times the price of copper.[10] However, the greater cross-section of the lighter metal requires extra support of the cable against stress by a steel core. Other uses for aluminum are based on its resistance to corrosion and chemical action, making it suitable for food and chemical containers and cooking utensils.

[8] U. S. v. Aluminum Co. of America, et al., 148 Fed. (2) 416 (1945), October Term, 1944, Docket No. 144, Reply Brief for the United States, p. 151.

[9] *An Outline of Aluminum,* Aluminum Company of America, Pittsburgh, Pa., 1940, p. 30.

[10] As 48 pounds of aluminum will replace 100 pounds of copper in an electrical transmission line. The lightness of aluminum offsets the greater cross-section required for equal resistance in unit length. *An Outline of Aluminum,* p. 34.

Malleable, aluminum may be forged, cast by different methods, rolled into plate, sheet, and foil, extruded into radio shields and tubing, stamped, blanked, spun, riveted, welded, soldered, and treated in other ways. It is cheaply machined, which, however, is also a sign of its weakness. It may be alloyed with magnesium, manganese, copper, nickel, beryllium, to improve or supply desired qualities of tensile strength, stiffness, etc.

POTENTIAL MARKET IN TRANSPORTATION

Aluminum has possible uses in the construction of transportation equipment such as aircraft, railroad and street cars, busses and trucks. Use of the light metal reduces fuel consumption and wear on tires.[11] Or else the pay load (cargo or passengers), may be increased without extra weight, as in commercial airlines or trucks. Since the first streamlined aluminum train made its debut in February, 1933, about a dozen were built up to the war period. In hopper cars for coal and sulfur, to which aluminum, but not steel, is resistant, the light metal may find another application in transport equipment. Aluminum lifeboats, which add stability to the vessel by saving weight at the top deck, have been used by the United Fruit Company and the Holland-American Line.[12]

These uses have been tentative and isolated, deterred by superior utility and lower costs of competing materials. Whether this means permanent failure for aluminum in general transportation depends on the possibilities of lowering aluminum prices by improved methods of production, or by acceptance of lower rates of profit. It also depends on whether aluminum alloys and fabrication methods can be improved as part of active promotion of a mass market in transportation. As yet, aluminum is harder to weld and solder and die-cast than other metals.

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[11] As European petroleum costs and taxes on vehicles were higher than those in America, weight savings have been a less important stimulus to this use of light metals here than they have been in Europe.

[12] "Postwar Prospects in Aluminum are Bright", *Metals*, July, 1943, p. 12.

In military aircraft, the weight saving of light metals permits greater traveling range (for more fuel can be carried), greater armament load, increased maneuverability in fighting, higher altitude range, and improved general efficiency.[13] About ⅓ of the pre-war industrial consumption of aluminum in the United States has been devoted to the construction of transportation vehicles in air and on land and sea. Other dynamic structures such as cranes, hoists, mine cages and cars have experimentally used aluminum because of its high strength-weight ratio. The lightness and workability of aluminum, and its resistance to oxidation and chemicals, adapt it to the packaging of a long procession of food and other products—toothpaste, candy, cheese, cigarettes, paint, drugs, etc. In these uses aluminum takes the form of foil, tubes, caps, and seals. Here, too, it competes with many substitutes—tin, zinc, lead, etc.

Electrical conductivity, increased by the greater and more uniform thinness of a new aluminum foil developed by the Reynolds Metals Co., makers of aluminum since 1940, promises use in electronics—in condensers, radar, and various communications devices. Corrosion resistance, especially in salt atmosphere, recommends the use of aluminum in marine electrical installations.[14]

WHY NO ALUMINUM AUTOMOBILES?

Aluminum could widen its uses in transportation by replacing steel in automobile bodies, crankcases, etc. After a sharp fall in the price of aluminum in 1908 and 1909, the metal was adopted for automobile accessories, and also for crankcases, footboards, cylinder heads, and other structural parts. However, improved technique of the steel companies in developing good steel sheet, stainless steel, and thin tubular steel, helped push aluminum out of automobiles.[15] The development of these improvements was apparently welcome to automobile manufacturers in view of Alcoa's control of aluminum prices. Ford, General Motors, and Budd were reported to have complained about the sharp increase in aluminum prices after 1915, when the automobile industry was trying to reach a lower-income market.[16] Consumption of aluminum in the making of automobiles declined from the high point of 41,810 metric tons in 1923 to 10,910 tons in 1934, or by 74%, while the production of automobiles dropped from 3,600,000 to 2,200,000, or by only 39%, in the same period.[17]

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[13] Norman E. Woldman, "Magnesium in Aircraft", *Metals & Alloys*, October, 1940, reprinted in *The Metal Industry*, December 13, 1940, p. 465.

[14] B. J. Brajnikoff, "Aluminum and Magnesium in the Electrical Industries", *Light Metals*, September, 1943, p. 429.

The American experience of declining aluminum use in automobiles has been duplicated in Great Britain. The standard 1939 model British car used aluminum only in pistons, as contrasted with wide application of cast and sheet aluminum in 1914 models.[18] The failure has been attributed to economic and technical causes. As over ⅔ of British cars sell for under £200, and at a low margin of profit, use of aluminum to accomplish a 20% cut in weight would entail at least a 7% increase in the selling price of a small car. Even in the 12% of cars selling over £250, aluminum is rarely used. Technical difficulties have impeded aluminum in this market. Even the reduction in chassis weight is minimized by the " overhead " weight of fuel, oil,, glass, passengers, etc., so that the net weight saving is pared down. It would take two or three years for the saving in fuel consumption, and in taxes based on engine size, to equal the added outlay on the more expensive aluminum car.[19] The aluminum price factor lurks behind the minimal economies attained here, but changes in design and in methods of working the metal to overcome technical objections are essential if the use of aluminum in automobiles is to be spread.

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[15] Donald H. Wallace, *Market Control in the Aluminum Industry*, Cambridge, 1937 (Harvard Economic Studies), LVIII, 254. Although the ratio of the prices of aluminum and steel was slightly more favorable to use of aluminum in 1924 than in 1920, the quantity of aluminum sheet used in automobile bodies declined sharply 1920-24. This might imply that the improvement of steel products was more important than current comparative prices in determining what would be used.

[16] Equity No. 85-73, Brief for the United States, pp. 190-98.

[17] Wallace, *op. cit.*, p. 61.

[18] Laurence Pomeroy, "Aluminium in Automobiles: An Analysis of Failure", *Light Metals*, Oct., 1943, p. 500.

Cooking utensils are one of the oldest outlets for aluminum, a good heat conductor. Aluminum, however, is also used as an insulator because it reflects radiant heat and light. One application is the protection of precision instruments and optical devices against radiant heat by the use of aluminum foil.[20]

SCRAP—A LIMITED COMPETITOR

In the iron and steel industry aluminum is used as a metallurgical agent (deoxidizer). It is in this use that scrap aluminum, cited by Alcoa as an effective competitor of virgin aluminum, is frequently employed. Scrap aluminum bought in the market, and secondary aluminum left as clippings, spillings, spoiled parts, grindings, etc. in the process of fabricating virgin aluminum (hence known as process scrap) have outlets chiefly in the production of aluminum castings, where requirements of purity and controlled chemical composition are lower than in other types of aluminum products. Sheet, forgings, and drawn products such as wire are not generally made with scrap, and the military aircraft industry, largest wartime user of aluminum, relies on virgin aluminum for its high-strength alloys in plane and engine. As noted by Dr. Francis C. Frary, Alcoa Research Director, the existence of unknown impurities in scrap is a barrier to full control of the metallurgical processes.[21]

Although Alcoa contended that scrap and secondary aluminum "are fully competitive metallurgically and in a market sense in an ever-increasing number of uses" with virgin aluminum, the assertion is at variance with the previous statements of Alcoa's own Research Director, as well as with the frank comment of Mr. Edward K. Davis, president of Aluminium Limited and brother of the chairman of Alcoa. Writing to his sales representative in London in 1934, Mr. Davis remarked:

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[19] *Ibid.*, pp. 502-5.

[20] Brajnikoff, *loc. cit.*, p. 430.

[21] Francis C. Frary, "Economics of the Aluminum Industry", *Industrial and Engineering Chemistry*, February, 1936, p. 151.

> It is fruitless to tell an old hand in the business . . . that you have reduced prices because of the competition of scrap. That is an argument that has been shot to pieces so many times that I am astonished that a seasoned warrior in the aluminium group should ever offer it.[22]

Scrap competed sufficiently with virgin aluminum in the castings field, however, to lead Alcoa in 1922 seriously to consider a scheme for control of the aluminum scrap market in order to control the price of aluminum castings, which it produced in competition with independent foundries. By buying up under half the market offerings of scrap, it was thought the price could be raised enough to offset any "peculiar advantages in manufacturing conditions" enjoyed by Alcoa's competitors.[23]

Standardization of the composition of aluminum alloys and reduction of their number facilitates replacement of virgin by scrap, as it is easier to identify the composition of the scrap.

AN ALUMINUM DWELLING?

Alcoa has cultivated a market for aluminum in architectural uses. With the technique of anodizing, aluminum acquires a weather-resistant colored surface which is decorative and adaptable to ornamental as well as structural uses in architecture.[24]

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[22] Equity No. 85-73, Exhibit 815.

[23] Equity No. 85-73, Exhibit 881. Mr. Cheyney of Alcoa's Cleveland office, wrote to Edward K. Davis, Sept. 9, 1922: "I was in Detroit last Friday and spent most of the day talking to Byrnes and Youngs about the feasibility of our controlling the market on aluminum scrap and the advantages to be gained to us, and principally to our sand casting business, by boosting the price of scrap as close to the price of new metal as possible." Control of scrap was also desirable to control the quality of castings and thereby to protect the good name of aluminum products.

[24] See "Production of Multi-Coloured Effects on Anodised Aluminium", by V. F. Henley, *The Metal Industry*, June 18, 1943, pp. 386-8 for a description of commercial processes used in producing colored finishes.

Cast and wrought aluminum alloys, if correctly designed, may be used in copings and other skyscraper components, to reduce the load on underlying structures; but these alloys are not usable in the basic structures themselves. Such alloys may find varied uses in prefabricated buildings (e. g., wall sections, kitchen and bathroom fittings), because they are light, have " dimensional stability in the presence of varying moisture", and take bolts, rivets, and hammer-driven screws better than wood does. Freedom from rust stains and ease of attaching metal appliances such as heating units give aluminum advantages in competing with cement-based building materials, stone, and wood. The gravity die-cast aluminum product is preferred for better surface finish and mechanical properties, but the cost and size of the large mold would require a mass market to permit use of aluminum in prefabricating large building parts. In the smaller parts a growing variety of substitutes exists.[25] The aluminum window sash is a more prosaic application than some dramatic dècors on public buildings, but one which may expand.

The following table[26] shows the distribution of aluminum among various uses in 1940:

USES OF ALUMINUM IN THE UNITED STATES — 1940

Use	*Per cent*
Transportation	40%
Foundry and Metal-working	23
Building Trim and Construction	5
Chemical Industries	5
Food and Beverage Equipment	2
Machinery and Electrical Appliances	9
Cooking Utensils	6
Electrical Conductors	5
Metallurgy	4
Miscellaneous	1

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[25] E. g., stainless steel, aluminum bronze, resin-impregnated plywood, thermosetting plastics, and asbestos compositions. G. Fejer, "Light Metals and Prefabrication of Buildings", *Light Metals*, Aug., 1942.

[26] T. S. Lovering, *Minerals in World Affairs*, New York, 1943, p. 279.

As this review shows, aluminum is a material of many uses. In the food, drug, and petroleum industries, aluminum replaces paper and tin as a packaging material; in the transportation, construction, and machinery industries it can often supplant steel and wood, in electrical transmission lines it competes with copper. Uncharted possibilities for aluminum exist in the field of electronics, furniture, automobiles, airplanes, machine tools. Even in the making of artificial limbs aluminum alloys combine lightness and strength, permitting the rebuilding of damaged responses. The broad usefulness of aluminum is definitely increasing. In the postwar period important applications can be extended and developed. In most of these, aluminum will compete with other materials.

NATURE OF THE DEMAND

The earliest uses of aluminum, before 1915, were chiefly in cooking utensils, the electrical industry, building and vehicle accessories or trim—fields where adequate substitutes already existed. Thus the demand for aluminum was relatively elastic —i. e., sales expansion waited on price reductions, or on increases in the price of substitutes. However, the demand for aluminum as a deoxidizer in the steel industry was always inelastic, because specific chemical properties were required. After 1915, applications of aluminum in transportation increased, particularly in aircraft.[27] Here aluminum were unique in offering a combination of lightness, tensile strength, corrosion resistance, etc. The new uses in this field generated a relatively inelastic demand, especially in two world wars, when aircraft became an absolute essential for which the government would, if necessary, pay any price.

On the other hand, with every important fall in aluminum prices, owing to changing conditions of supply, foreign competition, or other causes, the more elastic demand of new users

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[27] The Allied governments were reported to have used over 90,000 tons of aluminum in aircraft in 1918. World capacity (estimated) rose from 75-85 million pounds in 1914 to 175-180 million pounds in 1919. Wallace, *op. cit.*, p. 291.

(e.g., lower income groups) was tapped,[28] both in old uses such as cooking utensils, and in new uses such as electrical household appliances. These new markets reflected a shift from consumption of copper, zinc, enamel, etc., as consumers were led by the lure of lower aluminum prices.

Postwar demand will probably be relatively elastic in many uses, in spite of the likelihood of a peacetime aircraft boom, for new materials will join the corps of older metal substitutes for aluminum. (DuPont has announced that it can make wood as hard as steel.[29]) Production at or near Alcoa's present capacity will require the tapping of broad mass markets and the emergence of aluminum from the " fancy-goods " stage in structural and other uses.

In those uses where substitutes for aluminum have been few (that is, where the demand was inelastic), monopoly price policy tended towards high prices (and high profits). For example, in 1939, according to government calculations, Alcoa's gross profits on aluminum alloys used in airplane wings and fuselage (of which Alcoa was the sole source) were higher than gross profits on all other Alcoa products, amounting to a rate of 181% of cost on 24S alloy sheet. (Alcoa disputed the method and the meaning of the government's calculations.[30])

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[28] From the price history of aluminum, it is difficult to see which price cuts resulted from improvement of power supply, developing standardization of methods of work as experience accumulated, and other technical advantages accompanying passage from the laboratory to mass production, rather than from such conditions as business depressions, changes in other metal prices, foreign competition, and, finally, anticipation of competition or dissolution by court order after World War II. It might even be that cost savings would be passed on to consumers more rapidly when the second set of circumstances made this desirable. This surmise may find some support in the record of price increases which occurred during the market expansion of the first World War and soon after the passage of the Smoot-Hawley tariff, and in the jerky, rather than smooth, changes in aluminum prices over the course of Alcoa's history. For a cursory review of prices, see *infra*, pp. 235-9. (Wallace, *op. cit.*, presents a detailed record.)

[29] *New York Herald Tribune*, April 23, 1944.

[30] Equity No. 85-73, Brief for the United States, p. 185; Alcoa Reply Brief, pp. 478-87. Alcoa stated that per pound profits were not relevant and that

But the price of aluminum cable, which is competitive with copper transmission cable, was found to vary more closely with the prices of the materials from which copper cable is made, during the 1930's, than with the price of aluminum ingot.[31]

Extra profits made in the market of most inelastic demand made up for paper losses due to price-cutting in certain other markets where better substitutes existed. The fact that Alcoa was the sole supplier of aluminum ingot to fabricators who competed with Alcoa's fabrication subsidiaries gave Alcoa the opportunity for a "double-play" illustrating effective price discrimination. The price of ingot was controlled by Alcoa. In every year from 1927 to 1932, the price of aluminum sheet sold by Alcoa was maintained at a figure less than the sum of the market price of ingot and Alcoa's cost of fabrication (including the mill cost of rolling sheet and administrative and selling expenses).[32] This meant that other sheet rollers could not sell at a profit, so long as Alcoa maintained a narrow "spread" between the prices of ingot and of finished goods. Alcoa incurred no real out-of-pocket loss, however, because the market price of ingot in this period was far above the total cost of ingot, including all overhead charged to ingot.[33] Several competitors in sheet production were wiped out and others were kept from expanding. Postwar resumption of the "price squeeze" in sheet was enjoined by the appeals court in 1945. Cost factors which pave the way for price discrimination in various aluminum markets are discussed in Chapter II.

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profits on investment were more pertinent to the question of excess profits. According to Alcoa, it was wrong to emphasize *gross* per pound profits; profit on ingot was counted again in profit on finished goods; the apportionment of certain lump sum expenses was said to be incorrect.

[31] *Ibid.*, pp. 178-179. In 1932 the price of aluminum cable fell below the price of aluminum ingot.

[32] The price of sheet, 1928-32, was even less than the sum of the market price of ingot and the mill cost alone.

[33] *Ibid.*, pp. 188, 580.

ALUMINUM'S DANGEROUS RIVAL

Light and strong as aluminum products are, magnesium offers a real challenge to them. This sister light metal has a specific gravity of 1.74, and is thus ⅔ as heavy as aluminum, ¼ as heavy as iron, and ⅕ as heavy as copper. Although soft, like most pure metals, and deficient in mechanical properties, magnesium can be alloyed with most common metals except those in the iron and chromium groups.[34] The most frequent sand-cast alloy with a magnesium base is composed of magnesium, aluminum, manganese, and zinc. For certain uses zinc is omitted and silicon, cadmium, and copper may be included.

Magnesium may be more easily machined than any other metal, and is said to be nearly twice as easily machined as aluminum. The price of this quality is the softness and weakness of the pure metal. By heat treatment, the strength of some cast magnesium alloys may be made equal to that of high strength alloy castings by volume, and superior by weight.[35] Magnesium metal is most often finished by sand casting, but fabrication also takes other forms: die casting for small parts requiring smooth surfaces and little machining, press forgings for highly stressed parts, extrusion, forming of bars and plates, and rolling of sheet. Magnesium alloys compared with other structural metals on a weight basis have a very high fatigue endurance (that is, the ability to withstand repeated applications of stress), and superior tensile strength. By varying the alloy composition and the heating and ageing treatment, it is possible to develop different combinations of strength, ductility, and toughness, sacrificing one property to another beyond certain limits.

Magnesium has had certain disadvantages which may in part be overcome by proper preparation and use. Magnesium alloys are notch-sensitive, that is, " sensitive to local concentration of stress ".[36] It is therefore essential to avoid notches, scratches, or sharp corners. Magnesium is also susceptible like many other metals (but much more so than aluminum) to corrosion under certain conditions. Today this is much less an obstacle than formerly, owing to recent improvements.[37] Other handicaps of magnesium are: changes in yield strength and elongation at extreme temperatures (above 400° F.), poor resistance to wear except with ample lubrication or lining of the exposed parts, and a low modulus of elasticity, which can be overcome by corrugating or thickening stressed walls and by deepening sections.[38]

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[34] John A. Gann, " The Magnesium Industry ", Preprinted from American Institute of Chemical Engineers, *Transactions*, Philadelphia, 1930, XXIV, 15-17.

[35] Woldman, *loc. cit.*, p. 465.

The earliest use of magnesium was as a pyrotechnic agent in flashlight photography, as magnesium in powdered form ignites rapidly, emitting a very brilliant light. Robert Bunsen, founder of the present electrolytic method of producing magnesium, introduced the metal to the photographic industry in 1869.[39]

THE FIRE HAZARD

Fortunately for the industrial prospects of the metal, it is only as fine powder or ribbon, or in the presence of intense heat, that magnesium ignites, for in the mass, magnesium ordinarily conducts heat too rapidly to permit the ignition temperature to be reached locally.[40] Ignition of the metal during production by thermal processes, and during casting, grinding and heat treatment, has presented technological problems. Years of experimentation have conquered the ignition problem in theory, but it is still encountered in fact. Knowing that magnesium powder is inflammable, people feared that fires would break out in ordinary uses of the massive metal, and hesitated to buy it. In current years, the fire hazard has stalked metallurgical plants where magnesium chips, filings and grindings are stacked. The problem grows more serious as wider use of magnesium develops.[41]

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[36] *Ibid.*, p. 467.

[37] Manganese protects magnesium against corrosion. The higher purity of magnesium produced under present controlled and standardized conditions prevents corrosion. Proper design of magnesium products avoids cavities and pockets where moisture can accumulate. Lacquers, paints, enamels, and various chrome or anodizing chemical treatments are used to protect against the work of corrosion. Electrolytic action of magnesium in contact with brass, steel, etc., a leading cause of corrosion, can be avoided by plating with tin or cadmium. See H. W. Schmidt, W. H. Gross, H. K. DeLong, "The Surface Treatment of Magnesium Alloys", *The Metal Industry*, Jan. 3, 1941, for a discussion of the various processes used since 1907 to lend corrosion resistance and paint base qualities to magnesium.

[38] "The modulus of elasticity is very low, namely, 6,500,000 lb./sq. in. This is two-thirds the modulus of aluminum and about one-fifth the modulus for steel." Woldman, *loc. cit.*

[39] Walter J. Murphy, "Magnesium from the Sea... An Epoch-Making Achievement", *Chemical Industries*, November, 1941, XLIX, 6, 620.

Before structural alloys and fabrication methods were developed, magnesium was used in powdered form not only for flashlight work but also for military pyrotechnics—rockets, flares, signals, tracer bullets, and later, in incendiary bombs. Ribbon and wire were also made of magnesium, which is appropriately ductile. This chemically active metal found an important place in industrial chemistry and metallurgy—in the Grignard reaction synthesizing acids, alcohols, aldehydes, and other compounds, particularly in the manufacture of medicines and perfumes, and as a " deoxidizer " of various metals, notably nickel. Magnesium, rival to aluminum in some uses, is also a necessary alloy ingredient in high-strength heat-treatable aluminum alloys, including duralumin. Magnesium is also added in small amounts to the zinc-base die-casting alloys.[42]

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[40] Gann, *loc. cit.*, p. 14.

[41] Conflicting theories as to the best methods of controlling such fires prevail in industry, even among experts. Substantial agreement exists, however, as to the necessity of protective clothing, proper design of plant, cleaning of dust-producing machines, and cautious use of oil. Aluminum explosions and fires, while not as frequent a hazard as magnesium fires, do occur, particularly in the making of aluminum powder (used for paint pigment, thermite, and pyrotechnics) from scrap foil. Precautions parallel to those observed in the modern magnesium plant are essential. Experimentation with new methods of producing magnesium and of working both light metals also creates fire hazards in these industries. Dr. H. Berger, "Bases of Safety in Light and Ultra-light Alloy Manipulation", *Light Metals*, March, 1941, pp. 44-53.

AVIATION FINDS A PLACE FOR MAGNESIUM

By 1939-40 the aircraft industry used 80% of the magnesium alloy production in the United States, 60% of which entered into the construction of engines, the rest in the airframe and wheels.

> Magnesium alloy sheet was produced for the first time in 1939 for such interior parts of airplanes as walls, floors, seat and berth members, partitions, doors, and other secondary structures.[43]

Because of its ultra-lightness, magnesium is used in lightly stressed parts where the gauge thickness is hardly greater than that of aluminum alloys, and where sheet magnesium may be welded to castings or extrusions. (Welding is desirable, for belting or riveting adds extra weight and increases fatigue susceptibility.) In stressed parts like the monocoque fuselage, and wing structure, where magnesium has been used in German, Italian, and English designs, the sheet must be thicker to take the added strain, so that the use of magnesium saves no weight. But it does save time and construction cost, since riveting of thin gauge sheets of aluminum alloys or steel is avoided.[44] These uses have been far more developed in Europe than in the United States, where in early 1940 less than 1.2% of the weight of the average plane engine and 1% of the weight of airframe and propellor were supplied by magnesium.[45]

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[42] Gann, *loc. cit.*, pp. 14-15.

[43] 77th Congress, United States Senate, *Hearings before the Committee on Patents* [the Bone Committee], *on S. 2303, A bill to provide for the use of patents in the interest of national defense or the prosecution of the war, and for other purposes*, Part 2, April 20-25, 1942, pp. 934-35.

[44] See D. B. Winter, "Magnesium Sheet with Special Reference to Elektron", *Light Metals*, vol. XI, No. 13, February, 1939.

[45] A weight basis, of course, somewhat understates the extent to which this light metal is used.

At this time, aluminum accounted for 54-80% of the weight of plane and engine.

> Use of magnesium alloy sheet has been restricted by the difficulty of working it by standard shop practice, but it is now increasing as methods for riveting and welding evolved.[46]

New high-strength magnesium alloys have been developed for the stressed areas within the plane.[47] German planes captured by the British in 1940 had " a profusion of intricate magnesium parts running from nose frames to tail flaps " with a combined weight going up to ½ ton per plane.[48]

INDUSTRIAL MARKETS

Outside aircraft, magnesium has come to be used in increasing amounts in the production of portable machine tools, where a small weight saving in much-used drills, grinders, etc., reduces workers' fatigue and steps up efficiency. In

> reciprocating and moving parts of all types of machinery, the extreme lightness of magnesium overcomes starting inertia, decreases power consumption, reduces wear, and permits increased speeds.[49]

[46] " Magnesium Metal Light and Soaring " from the Industrial Bulletin of Arthur D. Little, Inc., Cambridge (The State College of Washington, Mining Experiment Station, *Information Circular No. 34*, March, 1941), p. 2. [Similar publications are hereafter referred to as *Inf. Circ. No.* —]

[47] Magnesium castings, in which the low machining expense has often " more than offset the somewhat greater cost of the magnesium parts " have replaced heavier and cheaper metals in aircraft crankcases, instrument housings, wheels and wheel support assemblies, and interior furnishings. Forged magnesium alloys have been applied in hydraulic jacks and other parts of the undercarriage and in engine supports. German applications were wider and more daring than those of England and the United States. " Present Status of Ultra-Light Alloys in Aircraft Construction ", *Light Metals,* February, 1941 (*Inf. Circ. No. 35*, April, 1941, p. 1).

[48] " Magnesium by the Ton, *Fortune*, March, 1944, p. 157.

[49] *Dowmetal Magnesium Alloys*, The Dow Chemical Company, Midland, Mich., 1943, p. 3.

Magnesium has found applications on a small, experimental scale, in textile machinery, packaging and bottling machines, farm machinery,[50] cranes, mine cages, electric and steam shovel dippers, and other industrial uses. In the office and home, typewriters, adding machines, cameras, and vacuum cleaners might be outlets for magnesium alloys. In the automotive industry, magnesium not only can add speed, tire-life, and fuel-saving, three qualities which recommended the metal to the Nazis for use in armored cars, but can increase the ratio of pay load to dead load in trucks and trailers and reduces the taxable gross weight, a factor of greater importance in Europe than in the United States. Henry Ford applied magnesium to generator end plates and horn resonators, but avoided using it in engine pans because of the extra cost. The German Ford plant, however, used magnesium more extensively in automobile production. Henry Kaiser believes that all-magnesium automobiles and planes are economically possible.[51]

THE TWO LIGHT METALS

It is in the field of cast products that magnesium offers most serious competition to aluminum and other metals. The lower cost of machining magnesium may eliminate the cost differential between high-priced magnesium and virgin aluminum castings. As the metal value is important in this use, scrap aluminum castings are cheaper than either virgin aluminum or magnesium castings. Magnesium alloys offer a 20-35% weight reduction over aluminum castings. Superior machineability of magnesium permits increased production with existing machining equipment—a saving in overhead costs as well as in labor time and human and mechanical energy expended in handling and using the lighter weight metal casting. Given a properly designed mold, most parts which can be cast in permanent mold in aluminum can be duplicated in magnesium.

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[50] But Ford had difficulty in selling magnesium tractors as farmers distrusted their light weight.

[51] "Magnesium by the Ton", *loc. cit.*, p. 201.

The threat which magnesium castings represented to Alcoa's sales of aluminum castings is shown in Alcoa's effort to keep the price of magnesium castings made by the Dow Chemical Company up to an agreed level to prevent encroachment on Alcoa's aluminum market.[52] The fabrication of magnesium in the United States in 1943 was in the hands of over 50 companies, 46 of which made only sand castings, in which form over 85% of the magnesium was fabricated. Sand castings, frequently of great size, are used in airplanes for engine crankcases, nose sections, brake and tail wheel assemblies, and many other parts.[53] About 10% of the fabrication was in the form of permanent mold castings, used for landing wheels, and die castings, used for shroud tube fittings and engine rocker box covers. A small fraction of the magnesium went to sheet rolling, forgings, and extrusions. These operations were performed by about 6 fabricators, among whom the Dow Chemical Company, sole magnesium producer from 1927 to World War II, and American Magnesium Corp., now a 100% subsidiary of Alcoa, were the leaders.[54]

Substitution of magnesium for aluminum has been impeded by the shortage of facilities for fabricating in the forms in which aluminum has attained pre-eminence—sheet, forgings, and extrusions—and by the backwardness of fabricating technique, which is being developed in the plants of the chief producers and consumers of magnesium ingot. The handling of aluminum has become more familiar to thousands of industrial workers who have made contributions to the art, and to soldiers. The possibilities of using aluminum in new applications have been appreciated by many executives.[55] The same is true of magnesium—on a smaller absolute scale, but relatively representing an even more significant change for this new metal.

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[52] Bone Committee Hearings, Part 2, Exhibit 36.

[53] Woldman, *loc. cit.*, p. 468.

[54] "Magnesium by the Ton", *loc. cit.*, p. 196.

[55] "Postwar Prospects in Aluminum are Bright", *Metals*, July 1943, p. 11.

Both metals have monopolies respectively of their markets as chemical and metallurgical reagents. Aluminum is hardly competitive with magnesium in the field of pyrotechnics. Notable progress has been made in making magnesium resistant to corrosion, and thus in making it a better substitute for aluminum, as well as for other metals. The light metals are complementary as well as rival materials, for each is used structurally only in alloy form, and each is a chief alloy ingredient for the high-strength alloys of the other. In a rather limited sense, then, neither can completely replace the other. It seems likely that aluminum will remain superior to magnesium until the technology of preparing magnesium for diverse uses has been improved to a point comparable with aluminum. As that point is approached, the relative prices of the two metals will be increasingly important in determining their marketability. Magnesium may cost more than aluminum on a pound basis and still compete effectively, since magnesium, being lighter, occupies with two-thirds of a pound weight a volume equal to that of one pound of aluminum. Therefore, if magnesium became a perfect substitute for aluminum, it would not be more expensive than aluminum at a price per pound one and one-half times that of aluminum.[56]

The simultaneous expansion of the market for both metals is possible, if prices are sufficiently attractive to users, if other materials do not compete too keenly, and if the postwar economy enjoys a high level of employment and production. Even if national production is not very large, light metals find a market at the expense of other structural metals in the most obvious cost-saving uses—portable machinery, transportation, packing machinery. The utility-increasing uses, such as electronics, furniture and household appointments, and building construction, depend more clearly on how much consumers earn and can spend. From the foregoing discussions of the many industries which were and can be important consumers of aluminum and magnesium, it should be clear that the social and economic importance of monopoly power on the part of the seller is potentially very great. Price factors definitely govern the substitution of one metal for the other.[57] This is especially true of magnesium, which is still not well-known. Price concessions here may have a potent effect in opening markets and breaking down prejudices.

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[56] The metals differ in thermal and electrical conductivity, tensile strength, ease of machining, corrosion resistance, and other qualities, but disadvantages of magnesium are being lessened by improvements in alloying and fabrication.

Fear of future price increases by a monopolist may impede introduction of a new material or use of an old one in new ways. The prices of aluminum and magnesium may influence the amount of expenditure on capital goods in which these metals may be used and so may affect the nation's production, employment, and income.

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[57] ". . . the material which serves best at the lowest ultimate cost will invariably be used", *An Outline of Aluminum*, p. 30.

CHAPTER II

ALUMINUM: RAW MATERIALS, PRODUCTION, AND CONTROL

Based on raw materials which are abundant and widely distributed the world over, aluminum ingot production has been subject to monopoly control in important industrial countries, including the United States. Chapters II and III attempt to explain how monopoly emerged in the American industry.

HOW PLENTIFUL IS THE RAW MATERIAL?

We may begin by inquiring how plentiful is aluminum " in the raw ". Aluminum occurs in chemical compounds in widely separated parts of the earth, and constitutes 8% of the world's igneous rock.[1] It is much more plentiful than iron or than nonferrous metals such as nickel, copper, zinc, and lead. Alumina (Al_2O_3) occurring pure is used for abrasives; it is known as sapphire, ruby, topaz, and emery, when found colored with metallic oxides. Of the many clay soils, rocks, and minerals, based on silicate of alumina, bauxite is the only one widely used for producing aluminum. Named after the town of discovery (Les Baux, France), bauxite consists of hydrated oxides of aluminum, with impurities of silica, iron, and titanium, and the separation of the alumina in bauxite from impurities is the first major step in the making of aluminum. A standard grade accepted by Alcoa for use in the Bayer process before the war had to be at least 55% alumina, with silica 7% or less (actually running as low 2-3%), and iron not more than 3-6%.[2] It takes 4 pounds of bauxite to make a pound of aluminum. Clays used experimentally for aluminum production include kaolinite and alunite as well as lower grade bauxite.

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[1] Erich W. Zimmermann, *World Resources and Industries*, New York, 1933, p. 699.

[2] Equity No. 85-73, Brief for the United States, December 2, 1940, p. 304.

Hungary is estimated to be the largest bauxite source in the world, with supplies sufficient to last 500 years at the 1941 rate of utilization.[3] Yugoslavia has a 200-year supply. France has enough reserves for 100 years, and abounds in high grades.[4] Untapped reserves of varying extent have been found in India, Brazil, the USSR, and elsewhere. One writer in 1936

> estimated world resources of high-grade bauxite at 1 billion tons, while the total reserves of all grades have been placed at up to 2½ billion tons. Considering further discoveries and the results of geological investigations since 1936 it is reckoned that the available amount of good ore may now be about 1¼ billion tons.[5]

Poor in bauxite, Germany has imported the ore mainly from Hungary and Yugoslavia.[6] The United Kingdom has relied on French deposits.

Aluminum production has been carried on in Norway, Switzerland, Germany, Great Britain, the United States, and Canada, on the basis of imported raw materials. The United States has bauxite in several states—Arkansas, Alabama, Georgia, Virginia, Tennessee, and Mississippi—but only in Arkansas is bauxite plentiful enough in metal-grade deposits to be used for aluminum production. The Arkansas deposits have been intensively used during the war, and it is probable that postwar aluminum production here will rest almost entirely on imported bauxite, unless clay-using processes are developed commercially.

American reserves of bauxite in Arkansas in 1943 were only 6,500,000 tons under 8% silica, as contrasted with wartime requirements of 5,000,000 tons a year.[7] Production of aluminum has therefore depended on imports, and on lower-grade domestic deposits used at higher cost. In addition to bauxite, the United States has an estimated reserve of only 12,000,000 tons of alunite, " a pinkish-white potash ore " with an alumina content of 20% or more.[8] But on the Pacific Coast alone clay deposits with alumina content of about 27% are estimated by the Bureau of Mines at 185,000,000 tons. Other sections of the country have not been really explored for similar deposits. Iron and silica impurities run as high as 50-75%. Many experimental processes have been devised to remove them—none, however, is yet able to compare in cost with the Bayer process based on bauxite.[9]

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[3] United States Bureau of Mines, *Mineral Trade Notes*, September 20, 1941, p. 3.

[4] *Loc. cit.*, November 20, 1941, p. 3.

[5] Robert J. Anderson, "The World Aluminum Industry", *The Mining Magazine*, June, 1941, p. 287.

[6] Germany turned to Hungary after France, in 1935, licensed bauxite exports, limiting Germany to 15% of the total. *Mineral Trade Notes*, October 20, 1941, p. 4.

THE DOMINANT GROUPS

To this broad array of raw material sources, the concentration of metal production offers sharp contrast. The associated interests of Alcoa and Aluminium Limited (Alted) in Canada dominate world aluminum production, controlling over 50% of the world's aluminum output and nearly 50% of the world's bauxite output.[10] Aluminum production under their auspices goes on in Canada, the United States, France (where the Alcoa group formerly controlled ¼ of the aluminum production) and Norway. Until 1940 Alcoa was the only producer in the United States. It is still the dominant firm, accounting for 93% of the 1943 capacity.[11] Aluminium Limited is the only Canadian producer. In Europe the position of Germany has matched that of Alcoa in the Western Hemisphere, with the Vereinigte Aluminiumwerke, A.G., controlling the dominant portion of the German industry, and outstripping the production facilities of the rest of the continent.[12] Prewar French aluminum production was in the hands of the Péchiney and Ugine interests which were united for marketing purposes through a joint sales agency, L'Aluminium Français. (See Chapter V). Swiss production rests in the hands of Aluminiumindustrie A.G. (Neuhausen); British production is monopolized by the British Aluminium Company, Ltd. Smaller Italian, Spanish, and Norwegian firms were largely owned by the major European and American concerns, which also owned bauxite deposits in Hungary, France, and Yugoslavia.

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[7] Arkansas had in addition 10,000,000 tons with 8-12% silica, and 11,000,000 tons of 12-16% silica content. *Congressional Record,* House of Representatives, October 14, 1943, pp. 8464-65.

[8] "Aluminum—Have or Have Not? ", *Fortune,* December, 1943, p. 258.

[9] *Ibid.*, p. 261.

[10] T. S. Lovering, *Minerals in World Affairs,* New York, 1943, p. 289.

[11] *Congressional Record, loc. cit.*, p. 8464.

Aluminum production is more centralized than bauxite production. The European aluminum producers, joined by Alcoa or Aluminium Limited, have been closely organized in cartels since 1901, the most recent being the Alliance Aluminium Compagnie, incorporated in 1931 for 99 years.

THE AMERICAN MONOPOLY

Alcoa, known before 1907 as the Pittsburgh Reduction Company (PRC), was set up in 1888 to produce aluminum in Pittsburgh. As it expanded, the company moved to a commercial plant at New Kensington, N. J. and in 1895 to Niagara Falls, where it was the first customer for power. The first ten or fifteen years of the PRC's existence were spent in perfecting the electrolytic method of production, and in developing an industrial market for aluminum as a deoxidizer in the iron and steel industry, in cooking utensils, mechanical parts, electrical transmission lines, and in automobiles. To acquaint the market with uses of aluminum, PRC set up its own foundry, wire-drawing plant, and equipment for other fabrication techniques. A competitive struggle with the Cowles Company (see below) ended happily for PRC in 1903, after which time PRC enjoyed a complete monopoly of aluminum ingot production.

Developing a policy originated some years before, PRC, protected by Cowles' patents until 1909, used the next years to expand and integrate. It acquired power properties, bauxite lands, foundries, a coal mine. It built an alumina plant and a carbon electrode plant. It set up a Canadian subsidiary and new fabricating plants. When its last patents expired in 1909, the company was in an excellent position to perpetuate control of domestic production, but had to cope with foreign inroads into the home market. These ended with the war, which caused considerable expansion of capacity and production, as well as profitable price increases. During the war, aluminum pistons and other parts were used in airplane engines and bodies. The engineering trades became familiar with the metal, now available in newly-developed strong alloys. After a postwar collapse of the market, and a spurt of imports, Alcoa pursued its expansion policy under the protection of new high tariffs. Foreign acquisitions (later put in the hands of a Canadian company, Aluminium Limited), steady research, and acquisition of new power sources, occupied Alcoa in the 1920's. Alcoa rose to the top in important branches of fabrication and was much criticized for price discrimination against competing fabricators who had to buy their metal supplies from the ingot monopoly.[13]

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[12] Lovering, *op. cit.*

During the depression until 1934, Alcoa tried to maintain prices. With the rearmament of the United States and the rest of the world, the aluminum market expanded. Alcoa was able to enjoy another period of exceptional prosperity in the Second World War. Capacity was increased, partly with Government aid. For the first time since 1903, independent production appeared in the industry. (See Chapter IX).

EXTENT OF CONTROL

As a guide to the extent of Alcoa's monopoly power, it is useful to recapitulate the allegations made by the Department of Justice in 1937.[14] The Government petition charged that:

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[13] Donald H. Wallace, *Market Control in the Aluminum Industry*, Cambridge, 1937, pp. 5, 9-14, 24-31, 43.

[14] Equity No. 85-73, Petition filed by the United States, April 23, 1937, paragraphs 41-53.

1) The Republic Mining and Manufacturing Company[15] owned or held 90% of the bauxite in the United States commercially suitable for aluminum; Alcoa controlled and used 100% of the bauxite produced in the United States for aluminum manufacture.

2) Aluminum Ore Company[16] at East St. Louis produced 100% of the alumina used in the United States to produce aluminum.

3) Alcoa and Carolina Aluminum Company[17] were sole producers of virgin aluminum in the United States—at Alcoa plants at Massena, New York, Niagara Falls, and Alcoa, Tennessee, and at the Carolina Aluminum plant at Badin, North Carolina.

4) Alcoa owned and controlled over 85% of the virgin aluminum produced and imported, plus competitive scrap or secondary aluminum moving in interstate trade; Alcoa imported over half the virgin imports.

5) Alcoa produced and sold over 90% of the aluminum sheet in interstate trade; over 95% of aluminum alloys known as duralumin moving in interstate trade; and virtually 100% of extruded and structural shapes, wire, transmission cable, bars, rods, tubing of aluminum and its alloys, in interstate trade.

6) Alcoa was the largest producer and seller of aluminum castings,[18] foil and bronze powder in interstate trade.

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[15] Incorporated 1929 as a 100%-owned subsidiary of Alcoa, to hold and operate bauxite properties formerly owned by Alcoa subsidiaries, American Bauxite Company and Republic Mining and Manufacturing Company.

[16] Organized as an Alcoa subsidiary 1929 to succeed an earlier company by the same name.

[17] Organized as Tallassee Power Company in 1906. Alcoa bought its stock in 1912, and to it in 1915 transferred properties of Southern Aluminium Company. (See Chapter V.)

[18] Through Aluminum Manufactures, Inc., organized 1919. In 1937 Alcoa owned 73% of the stock. This company acquired the properties of the Aluminum Castings Company, which Alcoa had set up in 1909 to consolidate independent castings companies with its own foundry. In July, 1922, Alcoa, then owing 58% of the stock of Aluminum Manufactures, leased its properties for twenty-four years, and acquired control of Aluminum Die Casting Cor-

7) Alcoa and the Aluminum Cooking Utensil Company[19] produced and sold about 50% of the aluminum cooking utensils in interstate trade. In addition, Alcoa owned 26% of the capital stock of Aluminum Goods Manufacturing Company, second largest utensil producer.

8) Alcoa and its patent licensees made and sold about 80% of the aluminum pistons entering into interstate trade.

9) Through its 100% monopoly of the production and sale of alumina and virgin aluminum, Alcoa had acquired and was maintaining monopoly control of aluminum and of basic fabricated aluminum products. Alcoa had the power to fix "arbitrary, discriminatory, and unreasonable prices", to extend and maintain control, and to exclude potential competitors.

Later in the suit the government no longer argued that Alcoa was monopolizing bauxite production and fabrication, but it did argue that Alcoa's activities in these fields were helpful in controlling virgin aluminum production.

BAUXITE—A SPRINGBOARD FOR CONTROL

Raw materials have provided a springboard for concentration of control in the aluminum industry, although aluminum-bearing minerals are plentiful. Lower-grade bauxite and clays cannot be used in the Bayer process, which requires high-alumina, low-silica ore. Not only are concentrated deposits of high grade bauxite necessary, but it is desirable that they be found near the surface, particularly if the deposits are too small to warrant the heavy expenses of underground mining. Most of the world's bauxite is obtained by surface rather than underground mining.

Commercial usefulness of bauxite is influenced by other geological factors, such as the thickness of the bed, the quantity of

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poration and a substantial interest in Aluminum Screw Machine Products Company. Alcoa now owns 100% of both. Thus Alcoa became the largest American producer of aluminum sand and die castings.

[19] Organized by PRC 1901 as a wholly-owned subsidiary manufacturing and selling cooking utensils.

"overburden" (earth, rock, brush, etc.) to be removed, and the plane of the vein. Availability of transportation is also important for economical extraction of this bulky raw material. It is also highly desirable, in the light of recent world history, that the deposits represent a politically safe source of supply, which means that they lie in the territory of one's own government or a government whose friendship is secure. Unsettled world conditions since 1914, as well as high transportation expenses, have therefore tended to rule out European bauxite as a leading raw material for American aluminum production in spite of a low tariff.

ALCOA'S BAUXITE CONTROL

Although it would be wrong to say that Alcoa cornered the bauxite supply of the Americas, Alcoa was able to corner high grade domestic American deposits and to exclude other interested parties from certain South American mines. From 1896 to 1939 Alcoa mined about 85% of the bauxite produced in Arkansas, sole important domestic source. Alcoa has imported about ⅔ of its requirements from Dutch Guiana, where it produced virtually 100% of the bauxite mined and, until 1928, when Alcoa transferred its British Guiana holdings to Aluminium Limited, it produced 100% of the bauxite output in that area.[20]

The adjacent counties of Saline and Pulaski, Arkansas, contain the leading bauxite deposits of the United States. There Alcoa acquired mining lands around 1900 after exhausting its Georgia mines. The three companies mining bauxite in Arkansas before 1900 were all bought up by Alcoa, and were under its control by 1909, when the Bradley patent expired.[21]

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[20] Equity No. 85-73, Brief for the United States, p. 392.

[21] These companies were: the Georgia Bauxite and Mining Company, the Southern Bauxite and Mining Company, and the Republic Mining and Manufacturing Company. The first had supplied bauxite to the Pennsylvania Salt Manufacturing Company, seller of alumina to Alcoa in the early days. In 1895 Alcoa bought a controlling interest. By 1899 Alcoa had virtually all its stock, and in 1901 dissolved the Georgia Company.

It is estimated that 90% of the metal-grade bauxite in the United States is controlled by Alcoa through its holdings of 14,058 acres in Saline and Pulaski Counties.[22] During the war the Reynolds Metals Company has used some lower-grade domestic bauxite for aluminum production.

"From 1918 to 1933 five separate organizations endeavored to acquire bauxite deposits with a view to engaging in the manufacture of aluminum. Not one of these organizations ever succeeded in entering the industry and not one of them has been shown to have been able to acquire any domestic bauxite deposits."[23] These organizations included: the Uihlein brothers (Republic Carbon Company); George Haskell (Baush Machine Tool Corporation); Central Aluminum Corporation (formed by a Detroit investment banker and aluminum fabricators serving the automotive industry); Bohn Aluminum and Brass Corporation; and the James B. Duke interests which, through the American Cyanamid and Chemical Company, already mined Arkansas bauxite for use in the chemical and oil refining industries.[24]

A considerable part of the testimony and argument in the 1937 anti-trust suit against Alcoa centered around Alcoa's contention that there was an ample supply of bauxite in the United States available to potential competitors, and the government's opposite contention. But when Alcoa was countering accusa-

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The second was acquired by Alcoa from General Chemical Company in 1905, at which time the latter agreed not to manufacture aluminum in competition with Alcoa. Alcoa dissolved the Southern Company or (as it was finally known) the General Bauxite Company, in 1907 and took over its lands, most of which have stayed in Alcoa's hands ever since. Alcoa obtained through General Bauxite Company between 55 and 85% of all the bauxite lands now controlled by Alcoa in Arkansas. The Republic Company was sold to Alcoa in 1909 by the Norton Company, which pledged itself by a restrictive covenant to refrain from encroaching on Alcoa. Over 90% of Alcoa's present Arkansas acreage was accumulated by 1909. *Ibid.*, pp. 402-5.

[22] *Ibid.*, p. 406.

[23] *Ibid.*, p. 443.

[24] *Ibid.*, pp. 428, 444-50.

tions that its purchases of foreign ore lands had a monopolistic intent, the company asserted that these acquisitions were merely attempts to supplement an inadequate domestic supply. This implies, however, that no domestic deposits remained to which Alcoa or anyone else could turn for more bauxite. Nor can the domestic shortage be attributed to intensified competition of industries using bauxite for non-aluminum purposes. For of the total bauxite supply 1916-1937, metallurgical uses took 72%, abrasives 12.3%, chemicals, 14.7%. There was no perceptible trend of increase in the quantity of the ore going to non-aluminum uses.[25] Moreover, if plentiful domestic bauxite had existed outside the range of Alcoa control, certain restrictive covenants into which bauxite companies entered would have been unnecessary and useless.[26] (See below, pp. 42-3.)

ALCOA FINDS FOREIGN BAUXITE

Alcoa acquired bauxite lands in southern France through a subsidiary, Bauxites du Midi, organized 1911-12 and also used to hold African bauxite lands. Later Alcoa organized bauxite subsidiaries in Yugoslavia and bought up bauxite properties in Italy. In its worldwide search for ore, Alcoa sent expeditions to France, Italy, Yugoslavia, Russia, Czechoslovakia, Rumania, India, and Africa. Its chief acquisitions, however, were made in British and Dutch Guiana.

Bauxite was discovered in British Guiana in 1912, and Alcoa immediately sent investigators to find and claim lands there. By 1914 the Merrimac Chemical Company of Woodburn, Massachusetts, together with Southern Aluminium Company, a French firm, were in conflict with Alcoa scouts. An agreement was reached for a temporary partnership, which terminated by a contract of December 3, 1914. Merrimac sold out its British Guiana interests to Alcoa in return for cash and for Alcoa's promise to supply Merrimac's chemical needs with bauxite for

[25] G. A. Roush, *Strategic Mineral Supplies*, New York, 1939, p. 227.

[26] Wallace, *op. cit.*, p. 107.

30 years at a special price. Large, choice bauxite properties along the Demerara River were bought up or leased from the British and Colonial governments by Alcoa. By 1928 the Demerara Bauxite Company, Ltd., an Alcoa subsidiary organized in 1916, held 24,816 acres with an estimated content of 16,500,000 tons of bauxite. Alcoa contested by legal action the attempt of the Uihleins to acquire bauxite lands in British Guiana.[27]

In Dutch Guiana Alcoa acquisitions were rapidly completed between 1915 and 1920 shortly after the discovery of bauxite there. In 1916 Alcoa organized Surinaamsche Bauxit Maatschappij to hold its Dutch Guiana properties. By 1937 this company had acquired over 95,000 acres and was the sole bauxite producer of the colony. Most of these holdings were obtained within 15 months after the explorations of Alcoa scouts in October, 1915.[28]

Thus Alcoa gained control of strategically located Guiana deposits on the north coast of South America, maintained ample raw material reserves for itself and apparently frustrated efforts of competitors, as correspondence and testimony in the 1937 suit would strongly suggest.

SIGNIFICANCE OF BAUXITE POLICY

The significance of Alcoa policies and activities in relation to the building of monopoly power cannot be precisely determined for several reasons:

1) Alcoa's cornering of high grade Arkansas deposits becomes less important with the stress on imported bauxite and the impending exhaustion of the Arkansas supply. But Alcoa control of Arkansas bauxite was important in 1909, when Alcoa's Bradley patent expired, legally opening the field to competition. When Alcoa purchased bauxite companies, the owners pledged that they would sell no bauxite to any other company

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[27] Equity No. 85-73, Brief for the United States, pp. 462-67.

[28] *Ibid.*, pp. 468, 471.

for use in aluminum production. The General Chemical Company, selling the capital stock of the General Bauxite Company to Alcoa in 1905, agreed that it would not

> use or knowingly sell any of . . . [that] bauxite . . . or any other bauxite, or the products thereof for the purpose of conversion into the metal aluminum and that upon proof that any of said bauxite or products thereof have been put to any such use it will not make any further sales or deliveries to the purchaser thereof.[29]

Alcoa paid the General Chemical Company $440,000 for stock having a par value of $100,000.

A similar agreement accompanied the purchase of the stock of the Republic Mining and Manufacturing Company from the Norton Company. Norton promised that it would not sell bauxite from a 40 acre tract in Saline County for the manufacture of aluminum nor sell or dispose of the tract without imposing the same restriction. Norton also tied its own hands with respect to any other bauxite which it might acquire in Canada or the United States.[30] These restrictive covenants, which were enjoined by the 1912 consent decree, helped Alcoa to strengthen its monopoly position while they were in effect.

2) But the frustration of competitors, even in this early period, was not entirely dependent on bauxite control. Power control, mastery of technique, and superior business strength of Alcoa had at least as great an effect. The lack of competitive ventures into bauxite mining may have reflected not only Alcoa's determined efforts to exclude others from the mines, but also a want of confidence on the part of possible competitors, who were made aware of Alcoa's other advantages.

This point is borne out by the recent exploitation of bauxite deposits in Brazil and the Caribbean region by Reynolds Metals Company, as soon as market expansion based on a secure government demand removed many of the risks associated with aluminum production in competition with Alcoa. Potential raw material sources in South America exist beyond Alcoa's present bailiwick.

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[29] Quoted in *ibid.*, p. 206.

[30] *Ibid.*, p. 211.

3) If methods based on alunite and other clays found within the borders of the United States should reach the stage of effective competition with the Bayer process, they will remove the monopolistic potentialities from bauxite control. Until they do, conditions of bauxite supply will have some influence.

FROM ORE TO INGOT

A survey of the way in which aluminum is produced will reveal factors favoring concentration and will help explain monopoly price policy.

The first step in the making of aluminum is the mining of its ore, bauxite, from open pits or from underground deposits by methods adapted from coal mining. By the process used in the Western Hemisphere, the bauxite is crushed, washed, calcined or dried to remove clay and excess moisture. The extra cost of removing excess water before shipment to the alumina plant is weighed against the saving in freight costs, especially in view of the long haul from South American mine to North American alumina plant, and against the technical advantages reaped later in the production process.[31] At the alumina plant, the bauxite is converted chemically into alumina, or aluminum oxide.[32]

Impurities in the bauxite are separated out from aluminum hydroxide by the Bayer process, developed by Karl Josef Bayer, a German chemist. The bauxite is dried, ground to a powder, and mixed with a hot solution of caustic soda (sodium hydroxide), by which it is " digested " in pressure tanks. The aluminum oxide compounded with water is dissolved out and the insoluble impurities are left suspended in the liquor. The aluminum hydroxide releases sodium hydroxide for re-use in the cycle, and is precipitated and thoroughly dried into alumina for shipment to the aluminum reduction works. Two tons of bauxite, two tons of coal, and 200 lb. of soda ash yield 1 ton of alumina.[33] The Bayer process can be used only with bauxite low in silica content, as silica unites with the liquor to form an insoluble compound, robbing the process of recoverable alumina and of caustic soda.[34] How to use other ores than low-silica bauxite by modifying the Bayer process has been a besetting problem to aluminum technologists.

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[31] Excess water causes loss of fluorine from the fluoride electrolytes by hydrolysis during the ultimate reduction of aluminum metal by the Hall-Héroult process. Francis C. Frary, "Economics of the Aluminum Industry", *Industrial and Engineering Chemistry*, February, 1936, p. 147.

[32] H. C. Parmelee, "Aluminum—From Bauxite to Rolled Metal", *Engineering & Mining Journal*, CXLIV, no. 9, Sept., 1943, p. 53.

At the aluminum reduction plant, alumina is electrolyzed to produce aluminum metal, by the process simultaneously invented in 1886 by Charles Hall in America and Paul Héroult in France. Alumina is dissolved in carbon-lined cells containing molten cryolite, a rich aluminous compound mined in Greenland or produced synthetically for use in this process. An electric current passes through the bath. The carbon lining, below which are ferrous contact bars, acts as the cathode, and aluminum, freed from the alumina by electrolysis, is deposited at the bottom of the cell. Suspended above the cell are carbon electrodes (anodes) or positive terminals, at which the oxygen is separated from the alumina by electrolysis. As the oxygen combines with the carbon anodes in gaseous form, the electrodes must be replaced periodically.

The aluminum is continuously drawn off from the cell bottom by a tapping spout, and cast into 50-pound pigs. The pigs are remelted to remove sodium, silicon, and other impurities and are recast into ingots. Alloying elements may be added to the aluminum during remelting. Fabrication into semi-finished or finished forms by rolling, casting, or other methods follows.[35]

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[33] Frary, *loc. cit.*, p. 147.

[34] *An Outline of Aluminum*, Aluminum Company of America, Pittsburgh, 1940, p. 15.

Because the ore must be prepared for the reduction of aluminum metal by the making of alumina, and because electrolysis consumes so much power, aluminum production uses up about 12½ times as much energy as iron production, which is a cheap, simple process of separating the oxygen from the ore by using carbon. When the entire process from bauxite to ingot is summed up, it is found that the following consumption of raw materials and energy takes place for every pound of aluminum produced: 2 lb. of alumina (or 4 lb. of bauxite), 4 lb. of coal, ½-¾ lb. of carbon electrodes, 12 kilowatt hours of electricity, and 11 cubic feet of natural gas.[36]

COST CHARACTERISTICS

Some characteristics of costs incurred in production shed light on monopolistic tendencies and price policy. Although most costs incurred up to the point of reduction of ingot may be attributed more or less directly to that product, the same is not true of fabrication costs or of overhead expenses such as administration or selling. Any major piece of fabricating equipment may be used to produce a variety of products. For example, a rolling mill may contribute to the production of several thicknesses of sheet, as well as foil and plate. When the general overhead costs are allocated among the products, the basis of allocation may be different elasticities of the demand for products competing with good or poor substitutes. This implies that little of the general overhead will be charged to products selling in the most competitive markets (e.g., electrical cables), a procedure encouraging low prices, while much overhead is borne by products selling at high and exceptionally profitable prices in a relatively non-competitive market (e. g., airplane sheet).

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[35] In rolling, the heated ingot is passed between rolls which are brought together gradually. Cold rolling in other mills produces sheet. Plate is rolled thick in one mill; foil is rolled very thin in a series of mills. Bars and rods are made by passing the metal through successively smaller openings in grooved rolls. Wire is made by drawing a rod through dies. Extrusion involves forcing the heated ingot through a die at the end of a cylinder, like "the squeezing of toothpaste from a collapsible tube." This has variations. In forging, heated metal is hammered in hammer dies, or is pressed in the dies of hydraulic presses. Sand casting (i. e., in a temporary sand mold) is used for small orders of large castings; die casting, for dimensional accuracy; permanent mold casting, for strength (as in pistons). *Ibid.*, p. 26.

[36] *Ibid.*, p. 22.

Fixed costs in aluminum production resemble, in general, those of other extractive industries. In the sense that the cost does not vary with the amount of production over short periods, the aluminum industry has important fixed costs in hydroelectric power facilities (dams, reservoirs, generators, transmission lines, idle surrounding lands, and future sites), and in the operations of surveying bauxite lands, clearing the overburden of rock, earth and plant life, and sinking mine shafts. In the sense that investment is so specialized that equipment is ill-adapted for transfer to another industry, aluminum potrooms (the system of electrolytic cells used in reduction of the metal from alumina) are an important "fixed" outlay for the industry.

As mining becomes more mechanized and attains a larger scale, it tends to be controlled by the aluminum producers, partly in the interests of better technical balance and control of quality, partly because aluminum monopolists in the producing countries have correctly regarded control of bauxite deposits as indispensable in meeting competition, so long as the Bayer process dominates.

THE SÖDERBERG ELECTRODE

Another cost-influencing factor in aluminum production is the method of producing carbon electrodes, needed in the electrolysis of alumina. Electrodes rate next to alumina itself as the second most important cost item. Even a modern aluminum plant consumes 0.6 lb. of electrodes to every pound of aluminum produced. The aluminum industry is by far the greatest producer and consumer of carbon electrodes among

American industries.[37] Alcoa has large investments in electrode plants at Badin, Alcoa, Tenn., and Massena; and in Canada, Aluminium Limited produces electrodes at Arvida. From these the bulk of the electrode supply for aluminum production is drawn. By the standard method, high grade petroleum coke is calcined, ground, mixed with pitch and tar, then pressed into a hard consistency, and finally, baked in a furnace to improve electroconductivity and reduce burning in air.[38]

The Söderberg process introduced a new continuous technique of making electrodes, which dispensed with the construction of an extra furnace or the consumption of extra heat.[39]

Interested in this method, Alcoa in 1924 bought a 55% interest in the Norwegian Electro-kemisk Co., owner of the Söderberg process, at a cost of nearly $500,000. Alcoa installed the new process in its Badin, and Alcoa, Tenn., plants, but abandoned the idea of extending the Söderberg electrodes through its Canadian and American plants because the cost of installation proved too high compared with the savings produced. The large size of the electrode was not adapted to Alcoa's small cells. In addition, electrode plants representing a fixed investment might have to be scrapped. The Reynolds Metals Company uses the newer process in its warbuilt plants in Alabama and Washington. Alcoa, however, did not use the Söderberg method in the new plants it built and managed for the Defense Plants Corporation.

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[37] Frary, *op. cit.*, p. 148.

[38] Frary, *op. cit.*, p. 149. Small electrodes, for the aluminum reduction pots, are made of very pure carbon, chiefly petroleum coke. Large electrodes used in the manufacture of alumina are made from anthracite.

[39] Loose ground carbon and pitch are fed continuously into a hopper suspended in the aluminum reduction pot or the arc furnace where alumina is made. In the Reynolds aluminum plant at Listerhill, Alabama, the hopper, forming an anode 4 feet wide and 10 feet long, is made of sheet aluminum with iron pins inserted through the casing to provide electrical contact. As the horizontal area of the Söderberg electrode is nearly as great as that of the cryolite bath, the alumina is electrolyzed between two continuous parallel surfaces. Cell action is more uniform, and power consumption is reduced owing to high ampere efficiency. Electrodes last longer, too, and the operations of pressing and baking the mixture are eliminated. Against these advantages must be compared the extra cost of the aluminum mantle or casing and of handling the iron inserts. The burned-up electrodes are continuously replaced; the baking uses the same heat as the simultaneous production of aluminum (or alumina). Equity No. 85-83, Brief for the United States, p. 312; Parmelee, *op. cit.*, pp. 57-8.

CHAPTER III

THE ALUMINUM MONOPOLY AND HOW IT GREW

LOOKING back over the years of Alcoa's growth, we find that most aspects of the company's business life have in some way been related to the strengthening of monopoly control.

THE ROLE OF PATENTS

Control of patents and technique has played a definite part in building Alcoa's monopoly power. In aluminum ingot production, patents were important to Alcoa in the formative period, which may have been a determining period, setting the pattern for future industrial organization. The basic patents expired many years ago—the Hall patent in 1906, the Bradley patent (defining an alternative electrolytic process) in 1909. However, Alcoa technicians have enjoyed the advantage of experience in technical control of the now-unpatented reduction process, even though the essential steps are theoretically simple and widely known. In the period after 1920, Alcoa apparently used piston patents to control an important fabricating branch of the industry.

While the electrolytic patents were in force, Alcoa, protected by its control of both patents, gained control of power sites and domestic bauxite sources through contracts which contained checks on potential competition. Patent protection was a shield of other restraining acts whose influence extended far beyond the period of patent monopoly. Patent protection permitted expansion of production, consolidation of fabricating outlets, accumulation of a corporate surplus—steps which prepared Alcoa to forge ahead after the patents expired. Wallace believes that Alcoa's heavy investments in power resources, and plant, reduction and finishing capacity, and domestic bauxite, beginning four years before the Bradley patent expired, armored Alcoa against competition in the period of growing demand 1905-14.[1]

On the international front, the Hall and Héroult patents served as the basis of the 1901 world aluminum cartel, in which Alcoa, then known as Pittsburgh Reduction Company, took part through a Canadian subsidiary. According to Wallace, one of the reasons for this cartel was the imminent expiration of the Héroult patents in Europe, and the desire of the producers to "present a united front to potential competitors after the life of the basic patents ran out".[2] But ample resources of bauxite and power in Europe permitted the entry of some new firms, and the cartel's effort was not successful.

ELIMINATING THE COWLES COMPANY

Patent litigation involving Alcoa's alleged misuse of its basic patents to exclude competitors has been ably recounted[3] and need be but briefly recapitulated here.

In 1889 the Pittsburgh Reduction Company began to manufacture aluminum in Pittsburgh, using the electrolytic process of Charles M. Hall protected by a patent issued in that year. After financial disappointments following his invention in 1886, Hall had joined forces with the Cowles Electric Smelting and Aluminum Company in Lockport for about a year, 1887-8. But the Cowles brothers, who had produced an aluminum alloy since 1885 by a sodium process, finally allowed an option to buy the Hall patent to lapse in July, 1888.[4] They did not lose interest in aluminum production, however, and began to sell pure aluminum in competition with the PRC in 1891. Vigorous price cutting brought the price of aluminum subsequently below the PRC starting quotation of $1.50 a pound.

Price warfare was paralleled by complex court litigation. Charging infringement of the PRC-owned Hall patent, the PRC secured a preliminary order restraining the Cowleses from

[1] Wallace, *op. cit.*, p. 102.

[2] *Ibid.*, p. 120; see also pp. 36-8.

[3] By Wallace, *op. cit.*, Appendix B.

[4] *Ibid.*, pp. 528-529.

expanding production or initiating price reductions during the trial of the infringement suit. In 1893 the Cowles brothers were declared liable for $293,907.94 damages to PRC for infringing on the Hall patent.

But this did not end the contest. The Cowleses acquired title to certain patents and applications of Charles S. Bradley, who had produced aluminum by electrolyzing fused ores as far back as 1883, antedating the Hall discovery. While Hall was superior in using alumina and cryolite together, instead of separately, as Bradley did, he did duplicate (whether or not copying directly) Bradley's method of melting the ore by the same electric energy used for the electrolysis, although he had begun his work at the PRC applying external heat by flame to the reduction pot.[5] Bradley's contribution is evaluated by Wallace in these words:

> [Bradley] at least seems to have been the first in this country to grasp the importance of the idea of simultaneous fusion and electrolysis of aluminum.[6]

Bradley's 1883 patent application was finally honored in 1892. When the Cowles Company finally received a clear title to the Bradley patent by court decision of 1897, it sued the PRC for infringement. In 1903 the Cowleses won the suit on appeal, thereby regaining what they had lost in the 1893 award to the PRC—namely, a footing in the patent-protected field of aluminum production.

But instead of taking a place in the aluminum market, the Cowles brothers accepted from PRC a cash grant of $1,136,000 for past damages and royalties on Alcoa's production after 1903, and cancellation of the $293,907.94 claim previously awarded to PRC in 1893. In return, the Cowleses agreed to sell exclusive rights to the Bradley patent to PRC, and to desist from electrolytic production of aluminum in the United States until the patent expired in February, 1909. The Cowles Company, in addition, was granted a preferential price on aluminum purchases from PRC of 146,000 pounds a year, and agreed to observe PRC's "published list price" for aluminum of any grade sold by Cowles in its jobbing business.[7] This agreement for price maintenance was not limited to the resale of aluminum bought from Alcoa.

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[5] Equity No. 85-73, Brief for the United States, pp. 202-03.

[6] Wallace, *op. cit.*, p. 537.

By the time the Bradley patent expired, one of the Cowles brothers was dead, and the firm was oriented towards other lines of business. The golden opportunity had been traded—the Cowles Company had been the leading potential rival of the PRC in aluminum production. The extra protection of three years after the Hall patent expired in 1906 gave Alcoa clear sailing past the 1906-7 business boom, when competitors might have been lured into the industry, and helped seal Alcoa's exclusive control solidly, at least against domestic rivalry.[8]

PISTON PATENTS

Aluminum alloy pistons, used to a degree in airplane engines during the First World War, were later applied extensively in the youthful automotive industry. A patent pool covering 98 patents on the "structure or configuration of aluminum pistons", i. e., "design patents", was set up by a trust agreement dated March 7, 1922, and naming the Cleveland Trust Company as trustee. Alcoa controlled 45 of the patents contributed. Out of 1500 shares in the pool originally held by Aluminum Manufactures, Inc., 1100 were received by Alcoa in 1922, when Alcoa leased the plants of Aluminum Manufactures, Inc., for 25 years. Behind the lease lies the story of Alcoa's alleged effort to draw under control the fabrication branch of the aluminum industry before the expiration of the Bradley patent.[9]

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[7] Equity No. 85-73, Brief for the United States, pp. 202-04.

[8] Wallace, *op. cit.*, p. 537.

[9] Equity No. 85-73, Exhibit 920, and Brief for the United States, pp. 227-30, 485-86. See p. 37, footnote 18, for the background of Aluminum Manufactures, Inc.

Alcoa also held important "process" patents covering the method of making aluminum alloy pistons by permanent mold casting. In 1924 Alcoa received from the Cleveland Trust Company an exclusive license under the structure patents, with the right to grant sublicenses. Alcoa granted to three foundries sublicenses under both structure and process patents, covering "a relatively small number of pistons". Two of the three, National Piston Company and Walker M. Levett Company, were taken over in 1927 by Bohn Aluminum and Brass Company, and their licenses were cancelled.

As Bohn itself had structure patents, covering the Nelson "strut-type" piston, which it had refused to put into the pool, Bohn was then able to make a deal with Alcoa. Bohn received a limited license from the Cleveland Trust Company on structure patents, and a process license from Alcoa, in return for licensing Alcoa directly under its own patents.[10] Bohn's license to Alcoa fixed minimum prices for piston sales, and included a pledge by Alcoa to observe these prices itself and to require other licensees to do so.

In 1937 only three firms had access to the 119 piston patents held by Alcoa and the Cleveland Trust Company: Alcoa, Bohn, and Aluminum Industries, Inc., Alcoa's third licensee. This situation reflected Alcoa's defensive action to protect its leadership in the manufacture of aluminum pistons. Alcoa rejected many applications for sublicensing under both structure and process patents, made by Ford, General Motors, Chrysler, and other interested parties. An Alcoa Vice-President was reported to have told the Vice-President of Packard in 1922 that Alcoa "intended to build practically all of the aluminum pistons that are to be built." [11] However, a number of small concerns made aluminum pistons without licenses, running the risk of penalties for infringement.

Against one of these firms, the United Engine and Machine Company of San Leandro, Calif., Alcoa initiated an infringement suit in 1931, to force this piston maker out of business, after refusing licenses under the patents whose infringement was charged. In 1933, Alcoa rejected the request of Packard that Alcoa license certain piston makers to provide Packard with a diversity of supply sources. Finally, one of these piston firms, the Sterling Company, was sued for infringement of Cleveland Trust patents. The piston story has close similarities to the tale of magnesium control by Dow Chemical Company, Alcoa, and I. G. Farbenindustrie, which will be told in Chapter VIII. Alcoa, it was alleged, used its patents to force sublicensees to buy their aluminum ingot from Alcoa, denied licenses to non-customers, and scaled the quota of pistons to which licenses were applicable according to the quantity of aluminum purchases from Alcoa.[12]

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[10] Equity No. 85-73, Brief for the United States, p. 487.

[11] *Ibid.*, p. 488.

Alcoa's lawyers in the 1937 suit denied, not the refusal to grant licenses, but the imputation of illegality:

> The Government leans heavily upon the argument that Alcoa later refused to grant licenses to others who made requests therefor and mentions as examples Ford, General Motors, and Chrysler. But it is well established that a patentee is neither bound to use his discovery himself nor to permit others to do so. It is not surprising that the automobile manufacturers were not licensed since they constituted the greatest market for aluminum pistons.[13]

THE SHORTAGE OF ALUMINUM EXPERTS

Shortage of technicians to start independent enterprise has been a factor in guarding the aluminum monopoly. This is paradoxical in view of the analytical simplicity of the production process. The restricted supply of Alcoa technologists has made it difficult to set up independent production, and has led to piracy—bidding away the experts from the only available source. The Cowles Company, for example, hired Alcoa's foreman Hobbs to superintend aluminum production in 1891.[14] The Uihleins were able to hire a number of former Alcoa men in 1917-18: Frank Kemmer, operating head of the Alcoa Badin plant, Broadwell, general superintendent of the Badin carbon plant, Smith, an engineer, and bauxite experts Reuben S. Peotter and Lloyd T. Emory. Arthur V. Davis protested vigorously.[15] Later Emory and two other former Alcoa employees with important jobs, Sinclair and Falter, went to work for the Duke interests, which were contemplating competition with Alcoa in Canada.

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[12] Aluminum Industries, Inc. repeatedly requested an increase in its license quota of 1925. Alcoa, refusing, charged Aluminum Industries with buying its aluminum requirements elsewhere and with undercutting the price of pistons. Increased quotas accompanied increased purchases of aluminum from Alcoa. *Ibid.*, pp. 490-3.

[13] Equity No. 85-73, Reply Brief of Aluminum Company of America and Other Defendants who are Represented by its Solicitors (except Aluminum Manufactures, Inc.), p. 274.

Expert manpower is a resource that cannot be completely monopolized under a competitive wage system, although the cost of assembling a complete working organization must be regarded as a substantial barrier to competition. The shortage of skilled organization played its role in preserving Alcoa power in the era of the Second World War, when aluminum production expanded.[16]

INFLUENCE OF POWER CONTROL

The high rate of power consumption in the electrolytic production of aluminum (10-12 kilowatt hours per pound of aluminum) renders imperative a vast supply of cheap power. Alcoa has built and acquired hydro-electric works where land values were low and other competitors were few. Power investments have offered both a cost-saving vertical integration of production, and a highly effective means of excluding competition. The story will occupy Chapter IV of this study. Here let us point out the highlights:

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[14] Wallace, *op. cit.*, p. 530.

[15] Emory had been manager, and Peotter managing director, of Demerara Bauxite Co., Ltd. before leaving. Equity No. 85-73, Brief for the United States, pp. 272-76.

[16] 77th Congress, 1st Session, United States Senate, *Hearings before a Special Committee Investigating the National Defense Program* (the Truman Committee) *pursuant to S. Res. 71*, Part 3, May 12-June 17, 1941, Aluminum, p. 848; Part 7, August 6-September 15, 1941, p. 2115.

Alcoa's acquisition of choice power rights and sites when the falls of Niagara were first harnessed by man; Alcoa's binding of power suppliers by restrictive covenants preventing sale of power to competing aluminum manufacturers; Alcoa's pioneer investments in the untapped streams of the Tennessee Valley; Alcoa's branching out abroad into the cheap power sources of Norway, reflecting, according to Arthur V. Davis, the exhaustion of cheap domestic power supplies. The final episode to date has been Alcoa's excursion into Quebec, taking over James B. Duke's power sites on the Saguenay River, with the dramatic climax of the wartime development of the Shipshaw site.

ALUMINA CONTROL

Control of alumina production dams up a possible leak in the wall erected by Alcoa around aluminum production. As the sole pre-war producer of alumina used in the United States to manufacture aluminum, Alcoa effectively forced any potential competitor to produce his own alumina (as Reynolds has done), or to give up in advance. That Alcoa recognized the strategic advantage that it enjoyed in alumina monopoly is shown by its reluctance to supply ingot-makers with alumina. The cases of the Norsk Aluminum Company and of the Aluminum Products Company in 1934 are pertinent here.[17]

Unless the government should produce alumina for sale to independent smelters, as once suggested by Mr. Reynolds, it appears that alumina production must be integrated with independent aluminum reduction, not merely for quality control, but for protection against dependence on Alcoa.

SIGNIFICANCE OF " OVERT ACTS "

How important in building Alcoa's monopoly were overt acts in restraint of trade or suppression of competition—the kind of action against which the Sherman Act spoke out most clearly? We have already mentioned denial of access to bauxite, power and patent rights as overt acts of this type. According to testimony and documentary evidence introduced by the Government in the 1937 suit, the part played by active fighting off, buying out, intimidating or otherwise obstructing competition was very great. Here we may summarize briefly the known important instances:

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[17] Equity No. 85-73, Brief for the United States, p. 481.

1) Potential competitors were subjected to restrictive covenants binding them not to use bauxite or alumina to produce aluminum nor to sell these materials to anyone else for such a purpose. (The General Chemical Company of New York in 1905, the Norton Company in 1909, the Pennsylvania Salt Manufacturing Company in 1907.)

2) In 1910 the principal stockholders of the New Jersey Aluminum Company sold Alcoa stock in the Aluminum Goods Manufacturing Company, and agreed not to manufacture, fabricate, or sell aluminum east of Denver for 20 years.[18]

3) Alcoa consolidated fabricating companies in 1909 through the organization of Aluminum Castings Company and Aluminum Goods Manufacturing Company, thereby obstructing access of possible competitors in ingot to sales outlets.[19]

4) When Alcoa in 1915 purchased the properties of the financially embarrassed Southern Aluminium Company, it prevented their passage into the hands of any competitors.[20]

5) Alcoa eliminated the potential competition of the Uihleins, Duke, and Haskell, 1924-6.[21]

6) Rival rollers of aluminum sheet were obstructed, harassed and bought out by Alcoa. They suffered from price discrimina-

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[18] The four restrictive covenants mentioned in 1) and 2) above were nullified pursuant to the 1912 consent decree, but had already been cancelled when the Department of Justice began its first investigation of Alcoa a year earlier, June, 1911. *Ibid.*, p. 216.

[19] *Ibid.*, pp. 227-30.

[20] *Ibid.*, p. 247. See Chapter V for full story.

[21] *Ibid.*, p. 270.

tion and from Alcoa's control of their necessary ingot supplies. The result was that in 1940 Alcoa was found to have sold 83% of the aluminum and aluminum alloy sheet sold in the United States since 1926.[22]

7) Alcoa was able to control aluminum's closest substitute, magnesium. (See Chapter VIII.)

These examples may have had an effect broader than their immediate impact, in so far as knowledge of Alcoa's attitude deterred unnamed and unknown enterprises from competing.

DEALING WITH FOREIGN COMPETITORS

How was Alcoa's prominence in the United States linked to the control of foreign competitors? Chapters V and VI discuss Alcoa's relations with the international aluminum cartels which it has helped to fashion since 1896. World division of markets, control of price competition, regulation or prohibition of dealings with non-members—all were important activities of the unusually strong aluminum cartels.

SUPERIOR BUSINESS STRENGTH

Another force behind Alcoa's monopoly was the superior business strength of Alcoa. This strength lies in vertical integration, which raises the minimum capital investment required of a competitor, or forces him to deal with Alcoa's terms at some stage of production or sale. Integration gives Alcoa power over prices in all markets. Alcoa has manipulated the " spread " (or differential) between prices of raw and finished aluminum to hamper a non-integrated competitor.[23] Alcoa's financial strength is another vital component in its business power. This strength was attained cumulatively by reinvestment of growing monopoly profits, and was increased by Alcoa's connections with Pittsburgh's banking interests through the holdings and influences of the Mellon family.

[22] *Ibid.*, p. 495.

[23] *Ibid.*, pp. 495-630.

THE MELLON CONNECTION

It was not long after Charles Hall's successful experiments with electrolysis in 1886 that aluminum became a Mellon metal. When Hall, working at the Cowles plant in Lockport, New York, was unable to finance his pending patents in 1887 and 1888, he was introduced to Captain Alfred E. Hunt, part owner, with George H. Clapp, of the Pittsburgh Testing Laboratories. (Hunt's son, Roy Arthur Hunt, became President of Alcoa in 1928).

Hunt and his associates put $20,000 into an experimental plant for Hall, but then turned to Andrew W. Mellon, and his brother, Richard B. Mellon, for aid in financing expansion to a commercial scale of production. The stock of the original Pittsburgh Reduction Company, formed in 1888, was increased, and an unknown amount passed into A. W. Mellon's hands. Mellon in 1891 provided funds, through a mortgage, for the new plant at New Kensington, New Jersey, and shortly after joined the board of directors. Richard B. Mellon was later included and became president after the death of Captain Hunt.[24]

The holdings of individuals, trust funds, and personal holding companies of the Mellon family group combined to retain a large minority of Alcoa stock in the hands of this important financial bloc. The Mellon family, foundations, etc., in 1939 owned 35.21% of the common stock, and Alcoa was listed as a company " in which the dominant stock interest is held by a single family interest group.[25] At least one Mellon has ordinarily sat on the board of directors of Alcoa (the late Andrew Mellon did so 1892-1921; Richard B., Richard's son R. K. Mellon, Andrew's son-in-law David K. Bruce, etc., have also been directors). In addition, the other large stockholding interests have been closely associated with the Mellons. Arthur

[24] "Aluminum Company of America ", *Fortune*, March, 1930, pp. 68, 70, 71; Harvey O'Connor, *Mellon's Millions*, New York, 1933, p. 81.

[25] 76th Congress, 3rd Session, Senate Committee Print, Temporary National Economic Committee, Monograph No. 29, *The Distribution of Ownership in the 200 Largest Nonfinancial Corporations*, Washington, 1940, p. 1489.

V. Davis, chairman of the Board of Directors of Alcoa, and owner in 1939 of 11.4% of the common stock, is listed as a director in the Mellon National Bank and in the Mellon-controlled Union Trust Company of Pittsburgh and in the Union Savings Bank.[26] Roy A. Hunt, president of Alcoa and owner, with his family, of 4.87% of the common stock, is a director of the same Mellon banks, and of the Mellon-dominated National Union Fire Insurance Company.

The Mellon influence tied Alcoa into a cluster of important enterprises controlled by the family. The cluster included, with Alcoa, 15 of the 200 largest non-financial corporations in the United States. Mellon holdings in these 15 totalled $473,600,000.[27] Total Mellon industrial holdings in 1931 were roughly estimated at $1,943,000,000, and Mellon financial holdings, at $511,000,000.[28]

Strong financial backing was essential to rapid progress in the aluminum industry, as the metal was untried metallurgically and commercially, and was challenging familiar metals with established markets. The cost of market campaigns and of research into new uses for the new light metal, and the risk of unsold inventories demanded financial strength. So did Alcoa's ambitious program of integrated control of bauxite, power, and fabrication outlets. Furthermore, the known existence of a powerful backer may have helped to command respect for Alcoa's market control. It is believed by Wallace that the lack of interest displayed by American bankers in financing competitive aluminum production, and in particular their failure to lend to the partially completed enterprise of Southern Aluminium when the World War demand had already begun, was a sign of their deference to the Mellon interests.[29]

[26] *Who's Who in America, 1936-7*, p. 684.

[27] *TNEC Monograph No. 29*, pp. 1514-21.

[28] O'Connor, *op. cit.*, pp. 423, 429.

[29] Wallace, *op. cit.*, pp. 113, 151.

MEASURING ALCOA'S FINANCIAL STRENGTH

The estimation of the exact rate of profit enjoyed by Alcoa during the years of its existence involves many theoretical and practical difficulties.[30] But the growth of owners' equity through unremitting reinvestment of profits is indisputable. Capital plus undivided profits of $500,000 in 1890 had expanded by 1939 to $181,000,000—an increase of over 3500%. A stock dividend of 100% was declared in 1904, and another 500% in 1909. In July, 1925, another recapitalization, providing for the merger of the Duke power properties on the Saguenay River with Alcoa, took place, in which $100 of common stock became exchangeable for $30 in common shares and $700 in preferred shares (all figures are par values)—i. e., a 630% stock dividend.[31] In addition, cash dividends over the entire period totalled $181,540,000, and cash payments for retired stock, $22,000,000.[32] On December 31, 1937, the corporation was ranked as 79th in size among the 200 largest non-financial corporations in the United States.[33]

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[30] Wallace (*op. cit.*, pp. 225-35, and Appendix C) takes Alcoa's net earnings after operating expenses—including depreciation, depletion, taxes and interest on current debt—and before interest on funded debt, and computes a rate of return on " investment ", which means average total assets during the year. This rate of return is believed to be an understatement of Alcoa's actual profit rate. (He suggests the possibility of excessive charges of depreciation and depletion, the diversion of earnings to executive salaries, and the incomplete presentation of subsidiary earnings.) Even so, the Wallace rate shows fluctuations reflecting varying opportunities of large monopoly returns, and suggests underinvestment and underproduction: the average rate of return 1909-14, being 17.6%; 1915-18, 19.3%; 1919-20, 9.4%; 1921-2, —2.3%; 1923-9, 10.2%; 1930-4, 2.6%. (*Ibid.*, p. 226.)

Wallace says these figures do not show the rate of return attributable to active rather than idle investment. Nor do the figures show earnings attributable to ingot rather than to all products. See Ch. X, p. 245 for a summary of the view of the appeals court on the significance of Alcoa's profit record.

[31] *Moody's Manual*, 1943, p. 384.

[32] Equity No. 85-73, Reply Brief for the United States, Filed January 10, 1941, p. 68.

[33] *TNEC Monograph No. 29*, p. 346.

This tremendous growth was the result of profit rates as follows:

ALCOA PROFIT RATES

(Net earnings after all interest and taxes, as a rate on capital plus undivided profit, or owners' equity)

1890–4	3.72%
1895–9	5.94
1900–4	16.07
1905–9	29.55
1910–14	17.64
1915–19	22.01
1920–4	3.59
1925–9	15.08
1930–4	2.35
1935–9	13.33
50-year average:	10.76% [34]

While the financial strength built up from past exercise of monopoly power has served as a protection to Alcoa against interlopers, it is also a vital test of the success of Alcoa's monopoly, and thus, indirectly, of the existence of a real social demand for aluminum products.

IS PRODUCTION INTEGRATED?

As the economist Thorstein Veblen was aware, business strength is not synonymous with maximum industrial efficiency, although the two may be related.[35]

While it is commonly believed that Alcoa is a thoroughly integrated concern, this is true only in so far as there is unified ownership, financial management, and planning of the production process up to and in part including fabrication. *Technological* integration appears complete only in that hydroelectric power plants are joined with aluminum smelters, and to some extent with fabrication facilities. Otherwise, the leading trait of Alcoa's organization is the marked geographical separation of the various steps in production of aluminum. Each location was chosen for some economic reason, but some of the reasons have become outmoded.

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[34] Computed from Equity No. 85-73, Exhibits 1709, 1735-37.

[35] See Thorstein Veblen, "Mr. Cummings's Strictures on 'The Theory of the Leisure Class'", *Essays in Our Changing Order*, New York, 1934, p. 27.

Alcoa's production of aluminum in the United States traces a tortuous itinerary. Bauxite travels from the northeast coast of South America to Mobile, Alabama, where it is refined into alumina or shipped by barge to East St. Louis, Ill., to be refined. New alumina plants run by Alcoa for the United States Government were located at Baton Rouge, La., and Hurricane Creek, Ark., where Arkansas bauxite has been processed. Some of the Arkansas ore also goes to East St. Louis but eventually all the alumina enters a common stream, travelling to aluminum plants at cheap power sites at Niagara Falls and Massena, New York, Badin, North Carolina, Alcoa, Tennessee, and Vancouver, Washington. During the war Alcoa added production plants at Burlington, New Jersey, Jones Mill, Arkansas, Maspeth, Long Island, Riverbank, California, Spokane, Washington, and Troutdale, Oregon. Part of Alcoa aluminum is fabricated near the reduction plant: sheet is rolled and aluminum powder and paste are made at Alcoa, Tenn.; Massena turns out wire, cable, rod, bar, and rivets; and Niagara Falls also produces sheet. But fabrication activities are also carried on in other large plants near Alcoa's pre-war industrial markets —Fairfield and Bridgeport, Connecticut, Cleveland, Detroit, Edgewater and Garwood, New Jersey, Buffalo, New York, Cressona and New Kensington, Pennsylvania, and Phoenix, Arizona.[36] The westward shift of markets, as the Pacific Coast became the site of airplane production, found westward movement of fabrication facilities lagging far behind. The result was an added cross-haul, as Vancouver-made ingot went nearly 3000 miles east to be made into sheet at Edgewater and New Kensington, and crossed the continent again to California's bomber plants.[37] One-third of American aluminum in 1943 was being produced (but not fabricated) on the Pacific Coast.[38] Realizing that the West Coast will be an important postwar market, Alcoa added some new fabricating facilities there. For a discussion of the degree of integration achieved in the plants built during the war by the Defense Plants Corporation see below, pp. 222-3).

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[36] Zimmermann, *op. cit.*, p. 704, and War Production Board bulletins.

Alcoa's acquisition of bauxite mines, power plants, fabrication facilities—in short, all its investments not directly channeled into aluminum potrooms—has increased the minimum of capital investment which outsiders would need in order to enter the industry. Any competitor is forced to integrate, in order to avoid dependence on Alcoa as a sales outlet for ingot, or as a source of the raw material at some stage of production. The most highly integrated aluminum production in the Western Hemisphere is organized in Canada by Aluminium Limited (Alted), which is controlled by leading stockholders in Alcoa.

GOVERNMENT POLICY TOWARD ALCOA

Finally, toleration and encouragement by the government can aid monopoly. Along the lines of direct encouragement, Alcoa has enjoyed the benefits of protective tariffs on aluminum and alumina, and low tariff rates on bauxite which it imports. The government has placed war orders, eliminating risk and guaranteeing profits, in two great wars, and, in the recent war, directly financed expanded production capacity. The question of government policy in wartime is of enough contemporary significance to warrant full treatment in Chapter IX.

Into the category of toleration of monopolistic activities falls the 1912 consent decree. Like so many others of its kind in American legal history, the decree enjoined the repetition of practices which had already gained the goal of eliminating or choking off competition, but did not affect the future orientation of Alcoa's business policy. All that it achieved was to drive Alcoa towards other methods.

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[37] "This cross-shipment adds to the cost at the rate of 2c. per lb. for freight alone, which could be saved if integrated plants were located in the far West". 77th Cong. 1st Sess., Sen. Rep. No. 480, *Special Committee to Investigate the National Defense Program,* June 26, 1941 [Mead Report], p. 6.

[38] Mr. Angell from Oregon, in *Congressional Record,* House, October 14, 1943, p. 8462.

The 1920's were distinguished by the presence of Andrew W. Mellon, a dominant influence in Alcoa, in the post of Secretary of the Treasury. The Fordney-McCumber Tariff Act of 1922 increased duties on aluminum. During the 1920's the Federal Trade Commission conducted protracted investigations of charges levelled against Alcoa's market practices, but took no punitive action. The revived interest of the government in monopoly-" busting " in the later New Deal period was felt in a drastic shift in public policy towards Alcoa, as an anti-trust investigation culminated in the filing of a government suit against the company in 1937. This action was no doubt related to Alcoa's liquidation or sale of certain properties mentioned in the government's petition, and to the emergence of a competitor in 1940. The rival firm, the Reynolds Metals Company, was manned by a vice-president who had conducted the government's suit against Alcoa.

The evaluation of past government policy and the consideration of future policies will occupy Chapter X of this study. At the end, perhaps, we shall be sufficiently aware of factors underlying light metals monopolies to consider what policies may be needed.

A "NATURAL" MONOPOLY?

The evidence reviewed in Chapters II and III should reveal the leading factors in Alcoa's rise to power. There is ample evidence of Alcoa's attempts to exclude others from the production of aluminum, the purchase or use of power and bauxite lands, the fabrication of castings, sheet, and other aluminum products. There is evidence of Alcoa's planned domination of certain corporations, entry into international agreements and other voluntary, deliberate acts of monopolization, in the sense of " contract, combination, or conspiracy in restraint of trade ". The explicit evidence of Alcoa's activities in controlling magnesium inferentially confirms Alcoa's practice in monopoly control of aluminum. Even a step such as integration, while justified on grounds of saving costs, has the simultaneous effect of warning off competition. The activities of Alcoa are not merely of historical interest, for in the recent expansion of production for war, Alcoa has been able to maintain much of its former control.

The technical and economic advantages of integration, of large scale production at any stage, and of a research budget, would tend to limit aluminum production to firms of substantial size. But this does not mean inevitable monopoly.

The activities which have accompanied Alcoa's rise to power as a profitable monopoly have obstructed the widening of the entrepreneurial ranks from monopoly to duopoly or oligopoly. It is not certain whether competition would have lived on past its birth; however, the integration of aluminum production does not require, for economy's sake, that only one firm exist, particularly in a country with the production and consumption capacity of the United States. How the growth of new firms would have affected profits is problematical for two reasons. First, there is no reason to assume a static demand had the number of firms increased. Second, we do not know what inter-firm relations would have emerged. A national cartel or informal price leadership might have replaced single-firm monopoly.

CHAPTER IV

POWER—A LEVER OF CONTROL

ALCOA IN POWER

Alcoa has been forced into a dominant position in the international hydroelectric power industry by its dependence on cheap power. The production of a pound of aluminum requires the consumption of 10 to 12 kilowatt hours of electricity. No other common electrochemical product, with the exception of magnesium and calcium carbide, consumes so much power in proportion to the weight of the product. The cost of electric power is so large a part of the total cost of aluminum that Alcoa has located its aluminum reduction works near hydroelectric installations to reduce the loss of power in transmission.

Ten to fifteen dollars per horse power year is the maximum that the aluminum industry has felt it could afford, and it must spend considerably less than this maximum to lower its costs and prices enough to build new markets. Alcoa, aware of this trend, has been " driven to the wilderness ",[1] and has quenched its power thirst in virgin streams, building power works in non-industrial areas where it would be the only important power consumer, indeed the first to harness the power potential of the locality. Moreover, if Alcoa could pre-empt power sources in undeveloped areas, the company could command the approaches to aluminum production. At the same time, by keeping its power costs low, Alcoa could enable its product to compete with other metals.

Although Alcoa controlled only 306,062 kilowatts, or less than 3% of the total installed hydroelectric capacity of the United States in 1938,[2] the power situation did protect Alcoa's monopoly. For not all hydro power is cheap and conveniently located. And economical manufacture of aluminum demands, not power in general, but power meeting special qualifications.

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[1] Francis C. Frary, " Economics of the Aluminum Industry ", *Industrial and Engineering Chemistry*, February, 1936, p. 147.

[2] Equity No. 85-73, In the District Court of the United States for the Southern District of New York, United States of America v. Aluminum Company of America, et al. Brief of Aluminum Company of America and Other Defendants who are Represented by its Solicitors (except Aluminum Manufactures, Inc.), pp. 99-102. (Hereafter referred to as Alcoa brief).

An aluminum plant must have firm power in large amounts —at least 30-50,000 HP. Not only is there a restricted natural supply of sites with so large a potential, but also they must be found in places where the land which must be bought and flooded can be cheaply acquired. The sites should also be accessible to transportation, labor, and markets. Hence the concept of an aluminum monopoly secured by control of selected power sites is far from imaginary. The vast Canadian powers controlled by Alcoa's associate, Aluminium Limited (Alted), far extend the scope of the suitable sites under unified domination. (Controlling blocks of shares in both Alcoa and Alted are held by the same families.)

In response to the accusations in the Government's anti-trust suit against Alcoa, filed in 1937, that the company has used power domination as a tool of aluminum monopoly, Alcoa argued that it pre-empted no power beyond its anticipated needs for " dog-in-the-manger " reasons. It claimed that its far-flung web of power control was spun to insure it a reliable source of power for future needs.[3] Convincingly Alcoa related the complex, tedious, years-long process of choosing, assembling, and developing power sites, and explained the high cost of acquiring lands flooded by dams, of erecting the dams themselves, of building powerhouses, etc. It showed how the energy potential of a single river is best utilized by building a series of dams rather than one.

So convincing is the analysis, in fact, that it is difficult to avoid the conclusion that the power investment imposes a barrier to newcomers in the aluminum field. There are instances, as well, which tend to confirm the allegation that it was overt acts of exclusion as well as the defeating psychological and financial effect of large capital requirements, which fashioned power into an important instrument of aluminum control.

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[3] *Ibid.*, p. 110.

ALCOA AT NIAGARA FALLS

By various restrictive covenants, Alcoa prevented power companies from which it leased land and bought energy, from supplying Alcoa competitors or producing aluminum themselves.

One of the two companies developing hydroelectric power on the American side of Niagara Falls before 1918 was the Niagara Falls Hydraulic Power and Manufacturing Company, later acquired by the Niagara Falls Power Company. The former company signed a contract with Alcoa on August 2, 1895, leasing to Alcoa certain lands at Niagara Falls, and arranging to sell mechanical water power to Alcoa for 25 years. The Hydraulic Power and Manufacturing Company agreed not to manufacture aluminum, nor sell or lease power to anyone for this purpose. Identical restrictive covenants appeared in later contracts between the companies, the last (signed in 1905) having a duration of 60 years.

The other of the two companies, the Niagara Falls Power Company, contracted on May 1, 1905, to sell Alcoa power for 15 years and to lease lands to the aluminum monopoly.[4] It agreed not to manufacture aluminum, nor to sell or furnish power to be used for aluminum production within the United States. Nor would it grant any rights for aluminum production to any rival of Alcoa in Canada, where Alcoa had already begun production, without giving Alcoa first chance at the opportunity at whatever terms were offered by the rival firm.

Subsequent agreements until 1921 repeated these restrictions, but both Alcoa and the Power Company aver that the restrictive clauses were cancelled by an agreement made in January, 1921. The Federal Water Power Act, establishing the Federal Power Commission, had become law in June, 1920. By the terms of the act, agreements to restrain trade in electrical energy disqualified applicants for Federal power licenses.[5] Had the Niagara covenants not been cancelled, they might have come under the scrutiny of the Power Commission. The New York State Power Authority Brief claimed that the cancellation was " a mere sham "; that it was not known to any of the officers or employees of the Company as late as 1936; and that its publication was both tardy and ineffective. Therefore, the Authority said, although the public had been aware of the restrictive covenants, it was not apprised of their formal retraction.[6]

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[4] This company began commercial generation of alternating current in the summer of 1895. Its first customer was Alcoa, then known as the Pittsburgh Reduction Company. On August 5, 1895, aluminum was first produced at Niagara Falls, the "greatest single source of constant water-power in the United States". The Niagara Falls Power Company acquired the Hydraulic Power Company in 1918 at the urging of the Secretary of War, who wished to conserve Niagara power. Edward Dean Adams, *Niagara Power, History of Niagara Falls Power Company, 1886-1918,* Niagara Falls, N. Y., 1927, II, 308-9.

That the 1921 cancellation was nominal is suggested by the failure of two independents seeking to begin aluminum production, the Uihlein family and George Haskell, to buy power at Niagara Falls as late as 1923. The Government's petition in the 1937 anti-trust suit against Alcoa charged that the restriction is still in full force and effect.[7] However, the demand for Niagara power has been so great in recent years that little or no power would have been available for an independent aluminum producer.

In the year after the cancellation, 1922, the Power Company granted Alcoa more mechanical power than it was getting before at a preferential price equivalent to about $10 for an electrical horsepower year. This rate compared favorably with the charge of $16 to other industrial customers. The preferential price was hidden by putting the reduction in the form of a rebate. Preferential rates to Alcoa were concealed for years by

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5 Federal Power Act, Revised to August 26, 1935, Section 10h.

6 Brief of the Power Authority of the State of New York before the Federal Power Commission, March 1, 1940. In the Matter of the Application by the Niagara Falls Power Company to Include in Project No. 16 Authority to Divert an Additional 275 Cubic Feet of Water per Second, p. 24.

7 Equity No. 85-73, Petition Filed by the United States, April 23, 1937, Par. 84.

the failure of the Power Company to submit these rates to the New York Public Service Commission. The Commission in 1937 started proceedings to force the Power Company to do this. Alcoa fought the order in court, and won a ruling that the Public Service Commission had no jurisdiction in the supply of mechanical water power by the Power Company to Alcoa. (289 N. Y. 357)

OTHER RESTRICTIVE COVENANTS

A third power company, the St. Lawrence River Power Company, signed a restrictive covenant when it sold to Alcoa, on February 20, 1903, the use of water powers near Alcoa's Massena, N. Y. plant on the St. Lawrence River. The company agreed not to use or sell power for the manufacture of aluminum so long as Alcoa remained in the business. In 1906 Alcoa acquired a controlling interest in this company.

Finally, the restrictive covenant was employed in the case of the Shawinigan Water and Power Company of Shawinigan Falls, Quebec. The Shawinigan company on August 14, 1899, entered into a ten-year contract to supply power to the Alcoa subsidiary (Northern Aluminum Co., Ltd.) operating a smelter and electric generators at Shawinigan Falls. The Shawinigan company agreed not to use or sell power for aluminum manufacture. Later contracts retained the early restrictions. When George Haskell tried to buy power from the Shawinigan company in 1924, he was refused as soon as his intention of making aluminum became known. In December, 1932, over 4 years after the transfer of Alcoa's foreign properties to Alted, the latter was substituted for Alcoa as guarantor of these power contracts.[8] The Government petition in 1937 alleged that the restriction imposed on the Shawinigan Company, now the " center of a web controlling the major power systems of Quebec. . ." " is still in full force and effect ".[9] Alcoa merely said in defense that, since Shawinigan Falls lies outside the United States, the contract was not subject to the scrutiny of the courts of this country.

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[8] Equity No. 85-73, Brief for the United States, December 2, 1940, pp. 222-24.

[9] Petition Filed by the United States, Par. 85; Legislative Document (1938), No. 89, State of New York, *Seventh Annual Report of the Power Authority*

INTEGRATION INTO THE FIELD OF POWER

Gradually Alcoa turned from buying energy under restrictive covenants to building dams at its own sites to control the water flow. This was part of Alcoa's program of integration.

Alcoa's first acquisition of hydroelectric property was the purchase of the St. Lawrence River Power Co. at Massena. Later Alcoa took over additional power properties on both sides of the St. Lawrence River. In 1907 Alcoa incorporated the Long Sault Development Company to round out the development of the International Rapids Section of the St. Lawrence River, by use of riparian rights along the Long Sault section of the St. Lawrence. But ". . .the charter granted by the State of New York was found unconstitutional and repealed " and in addition the Governments of Canada and the United States opposed the move for private exploitation of this great power resource.[10] Although Alcoa turned to Southern power sites when this plan failed, it did not give up hope of turning the St. Lawrence to account.

Alcoa began to buy lands and riparian rights along the Little Tennessee River, a main tributary of the Tennessee River, which rises in north Georgia and flows through North Carolina into Tennessee. First, Alcoa bought the Knoxville Power Company in 1910, which owned undeveloped riparian land along the Little Tennessee. Gradually Alcoa bought up properties from all the other power companies which had started in the Little Tennessee Valley, and by 1914 had a large enough block to build its first hydroelectric units.[11] The Cheoah dam and powerhouse

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of the State of New York for the year ended December 31, 1937, p. 41 (hereafter referred to as Leg. Doc. No. 89).

[10] *Ibid.*, p. 34.

[11] Alcoa brief, pp. 125-26.

were installed in 1919 and the Santeetlah (North Carolina) dam was completed in 1928. This was followed by the dam at Calderwood, Tennessee, which was completed in 1930. Other dams along the Little Tennessee were planned; over a period of years Alcoa

> acquired ownership of varying amounts of riparian lands at the dam sites and in the reservoir areas of the Chilhowee, Fontana, Needmore, Nantahala, and Glenville projects, with a view to the future development of these projects.[12]

Two projects of the Nantahala Power and Light Company, Alcoa subsidiary, located on the Nantahala River, which joins the Little Tennessee at Almond, N. C., and on the west fork of the Tuckasegee River, were constructed to meet power needs of World War II.

THE FONTANA SITE

The most important plan of Alcoa was for the development of the Fontana site, which is considered by the TVA to be " one of the major developments in the Southeast. . . .It has an unusually strategic location from the point of view of the operation of the entire watershed, being located in one of the main tributaries of the Tennessee River System ".[13] Since 1914 Alcoa had been accumulating the necessary parcels of land for the project. Fontana is not only a power site but a dam project significant for navigation and for flood control in the valleys of the Tennessee and Mississippi Rivers. The planned reservoir, with a usable storage capacity exceeding 1,000,000 acre-feet, was to be the fourth largest east of the Mississippi River.

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[12] *Report to the Congress on the Unified Development of the Tennessee River System Submitted by the Board of Directors of the Tennessee Valley Authority,* March, 1936, pp. 104-5.

[13] 77th Congress, 1st Session, United States Senate, *Hearings before a Special Committee Investigating the National Defense Program* (the Truman Committee) *pursuant to S. Res. 71,* Part 3, May-June, 1941, Aluminum, p. 937.

Under the Federal Power Act, the Federal Power Commission had power to require a license for intended private developments if they affected the interests of interstate commerce, or were constructed in the navigable waters of the United States, or involved Government lands. Finding after investigation that the Fontana project would affect navigation on the Little Tennessee and Tennessee Rivers, and interstate commerce, the Commission in November, 1940, required Alcoa to apply for a license. This would have included a clause providing for the eventual recapture (not confiscation) of the project by the Government. Under the Water Power Act of 1920, the Government had the right to take the plant after 50 years after paying the owners their legitimate investment less accrued depreciation. Alcoa was not willing to ask for a license under such conditions, and "asked that all proceedings be dropped" [14] The Federal Government then had the task of developing the strategic Fontana site.[15]

As the pressure of wartime power needs impelled the TVA toward an expanded construction program, a contract was finally signed with Alcoa on August 14, 1941, turning over the Fontana site to the TVA. No cash was paid, but Alcoa was compensated by the better storage facilities which brought a more even river flow to Alcoa's downstream dams at Cheoah and Calderwood. All five Alcoa dams on the Little Tennessee are now under integrated TVA operation as part of the area's power pool, although Alcoa still owns these properties.[16]

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[14] *Twentieth Annual Report of the Federal Power Commission*, 1940, p. 18.

[15] As Alcoa doubted the power of the Commission, it awaited the settlement of the New River case [U. S. *v.* Appalachian Electric Power Co., 311 U. S. 377 (1940)], which the Supreme Court decided in favor of the Commission on December 15, 1940, before dropping its plan. In 1925 the Appalachian Electric Power Company had filed with the Federal Power Commission its intention to build a dam and power plant on the New River. (The New River, flowing through three states, runs into the Kanawha River and thus into the Ohio River.) The FPC wanted the company to obtain a license providing for eventual recapture of the property and surrender of excess profits. After years of litigation, the Supreme Court received the case on appeal by the FPC. On December 15, 1940, the Court decided that the Federal authority over streams and rivers under the interstate commerce clause in the Constitution is not limited to navigation, but embraces as well floods, watershed development, and recovery of costs of developments through utilization of hydro power. The decision asserted that a stream is to be considered navigable if it can be made so by reasonable improvements, even if none are contemplated. The decision was interpreted as a vindication of the FPC's broad claims to authority. *New York Herald Tribune*, December 16, 1940, and January 11, 1941.

Interrelations between Alcoa and TVA have a history dating back to 1936, when Alcoa contracted to buy power from TVA. In 1937 Alcoa increased this order to serve increased aluminum plant capacity. The parties agreed to furnish power to each other in emergencies. This proved a boon to Alcoa during the dry months of 1940 and the severe drought of 1941. Regular power interchanges between the two systems were also of service to TVA.[17] After 1941 Alcoa increased its power purchases from TVA again to supply the new Alcoa aluminum plant and rolling mill at Alcoa, Tenn.

The Government-owned aluminum plant run by Alcoa at Lake Catherine, Ark., used power bought from the Southwest Power Pool, an organization of private utilities, and from the Ark.-La. Electric Cooperative, a protêgé of the Rural Electrification Administration, which transmits power from Pensacola Dam on Grand River, Okla.[18]

The willingness of the Federal Government to undertake the investment needed for great power developments, and the controls enforced by the FPC over private development, have encouraged Alcoa to rely on power purchases once more, particularly for emergency use by plants whose operation may not be essential in Alcoa's permanent plans.

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[16] C. Herman Pritchett, *The Tennessee Valley Authority, A Study in Public Administration*, Chapel Hill, 1943, pp. 39-40, 189.

[17] *Annual Report of the Tennessee Valley Authority for the Fiscal Year Ended June 30, 1938*, I, Washington, 1938, 151, 60.

[18] 77th Congress, 2nd Session, Union Calendar No. 666, House Report No. 1873, *Interim Report, Special Committee No. 3 on Materiel, Procurements, and Personnel, Committee on Military Affairs, Pursuant to H. Res. 162*, March 5, 1942, pp. 3-4.

THE YADKIN RIVER PROJECT

Alcoa acquired another Southern power site in 1915, when it bought the properties of the French-owned Southern Aluminium Company on the Yadkin River in North Carolina. The properties of the distressed company included an unfinished dam and power plant, and an aluminum plant at Badin, N. C. Alcoa said that the plant was purchased to fill urgent war orders and to meet future power needs. Through this purchase, Alcoa kept the facilities off the market and out of competitors' hands, and saved the French aluminum company from considerable loss. The power flow on the Yadkin River, and especially at Badin, N. C., site of Alcoa's aluminum plant, was so variable that in 1926-7 Alcoa had to build the High Rock Dam to regulate the flow.[19]

By 1940 Alcoa had developed three sites on the Yadkin—at Yadkin Narrows, at Yadkin Falls, below the Narrows, and at High Rock, 9 miles above the Narrows. A fourth site at Tuckertown is still undeveloped, for the following reason, as interpreted by the Federal Power Commission:

> The [Federal Power] Commission's efforts to assure orderly development of the country's water-power resources under a broad conception of the importance of Federal authority over streams have been hampered by the resistance of certain private power interests to the requirement that they obtain licenses for water-power developments. This resistance has extended beyond the refusal to take out licenses for already constructed projects to decisions not to undertake needed power developments because the Commission found that a license would be necessary. This laid the ground for a specious argument that the Commission by requiring licenses was actually retarding the utilization of the country's water-power resources. A specific case is that of the refusal of the Carolina Aluminum Company of America (Alcoa subsidiary) to go ahead with its Tuckertown project on the Yadkin River in North Carolina. Today that project would be of inestimable

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[19] Alcoa brief, p. 129.

> value for the production of aluminum for the national defense program if the company had been willing to proceed under a license under the Power Act.[20]

Since 1922 Alcoa has neither bought nor, with the exception of Tuckasegee and Nantahala, developed any power projects within the United States. The available domestic resources of cheap power adapted to aluminum production were thought to have been exhausted. The exceptions of the Bonneville and Grand Coulee projects on the Columbia River in Washington, as typical of Western projects later developed or planned under public sponsorship, were far from Eastern metal markets. Bonneville, Grand Coulee, and TVA involved as well a tremendous power potential beyond the requirements of the aluminum industry and beyond the ordinary investment capacity of private capital.

FOREIGN POWER ACQUISITIONS

Between 1922 and 1926 Alcoa purchased important or controlling stock interests in four Norwegian aluminum companies owning water power sites, in a French power company, and in Saguenay River power sites in Canada. The reasons for this entrance into the international power field were cogently marshaled by Arthur V. Davis, Alcoa president, writing to the Attorney General on May 25, 1922 to defend Alcoa's acquisition of control in the Norsk Aluminum Company:

> We are confronted, in providing for future expansion, with the constantly rising cost of hydro-electric power and even today the demands for hydro-electric power are such that at certain of our plants it is more profitable for us . . .to use our . . . power for public service work and light manufacturing than for the manufacturing of aluminum. Competitive aluminum prices make it difficult, if not impossible, to sell aluminum at such a rate as will make as great a return on the . . . power as if the power were sold for general distribution

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[20] *Twentieth Annual Report of the Federal Power Commission*, pp. 15-16.

> and this will be increasingly true in the future . . . it is necessary for us to get a foothold where water power exists in large quantities and . . . (can) be used for electro-metallurgical purposes without constantly competing with the high-priced demand of domestic and small industrial consumers.[21]

In Canada, the association of Alcoa with the Duke interests in the control of cheap Saguenay power deserves study as an example of activity which simultaneously prevented competitive aluminum production and entrenched Alcoa in what has proved to be a leading water power resource of the world. A further result was the expansion of production capacity beyond the reach of regulatory agencies of the United States Government.

THE STRUGGLE FOR SAGUENAY POWER

The Saguenay River in Quebec drops 300 feet between Lake St. John, which has an area of 400 square miles, and sea level at Chicoutimi. The tremendous volume of its flow permits hydro power production on a grand scale. The Upper Development of the Saguenay at Ile Maligne lies within a mile of the St. John outlet; Shipshaw, the Lower Development, with a head of 200 feet, lies 18 miles downstream. This was virgin territory. Not only could Alcoa benefit by lack of competition from other industries for power, but also it could meet its labor needs at attractive prices.

In 1899 and 1900 Quebec made its first grants of the Saguenay power sites to private persons. James B. Duke, organizer of the American Tobacco Company and president of the Southern Power Company, became interested in Quebec power about 1914 and acquired the grants at a cost of $1,000,000. Duke joined forces with Sir William Price, whose newsprint firm was a large consumer of power. Together they created the Duke-Price Power Co., Ltd. In 1924 this company built a power station at the Ile Maligne site, with a planned capacity of

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[21] Equity No. 85-73, Exhibit 892.

350,000 horsepower.[22] The Duke-Price Power Co. was owned by the Quebec Development Co., Ltd., of whose stock Duke owned 62½%, and Price most of the rest.

ELIMINATING THE UIHLEINS AND HASKELL

Meanwhile the Uihlein family interests of Milwaukee had been investigating the possibilities of manufacturing aluminum. They hired Alcoa experts to manage their venture, and plunged into a lengthy search for bauxite and power resources. At Niagara Falls, and on the Tennessee and Yadkin Rivers, they found no suitable power sites over 50,000 HP, regarded by them as a minimum economical size, which had not been preempted by Alcoa.

In the fall of 1924, having found enough bauxite in British Guiana to start operations, Joseph Uihlein was invited by James B. Duke to inspect the Saguenay River power properties. They were unable to negotiate a satisfactory arrangement for production of aluminum. Finally, the Uihlein interests offered to sell out their bauxite to Alcoa, along with their plant (the Republic Carbon Company) producing electrodes at Niagara Falls.

Uihlein warned Arthur V. Davis that Duke was planning to produce aluminum, and would buy out the Uihlein investment if Alcoa did not, and also spoke of his trip to the Saguenay power sites. Within two months after the Uihlein-Davis conference, in December, 1924, Alcoa bought up the Republic plant, in association with the Carborundum Company and the Acheson Graphite Company.[23] Both co-purchasers were allegedly friendly to Alcoa and to the Mellon family, its dominant stockholders. Andrew W. Mellon owned stock in Carborundum and Acheson. As Republic Carbon had legal title to the Uihlein bauxite deposits, the Uihlein aluminum venture thus passed entirely under Alcoa's control.[24]

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[22] Herbert Marshall, Frank A. Southard, Jr., Kenneth W. Taylor, *Canadian-American Industry. A Study in International Investment*, New Haven, 1936, pp. 103-4.

[23] Brief for the United States, pp. 290, 293.

But this was merely the first step in preventing competition from the Duke power sites on the Saguenay. For George Haskell, backed by powerful automobile manufacturers, to whom Haskell's firm, the Baush Machine Tool Company, sold aluminum parts, was trying to start aluminum production. Early in 1924 Haskell approached the Quebec Development Company, Ltd., of which Duke was president, in an effort to purchase power for aluminum production. He had unsuccessfully tried to find domestic power for less than $20 a horsepower year—a prohibitive price for aluminum production. Haskell obtained from Duke an option on a twenty-year contract for 50,000 horsepower at Ile Maligne, in the spring of 1924. After a trip to Europe to sound out an aluminum supply and observe reduction methods, Haskell returned with a detailed plan for a joint aluminum enterprise. As the Duke group wished to launch an integrated company owning its own bauxite reserves, it sent an executive to seek bauxite in French Guiana.

The planned size of the Saguenay aluminum plant was finally put at 20,000 tons a year. Elaborate preparations were made. Then suddenly, in November, 1924, Haskell learned of negotiations between Arthur V. Davis and Duke, and not long thereafter was informed that the Quebec Aluminum Company had been formed without his knowledge—in short, Haskell was being dropped.[25]

After months of negotiation, Alcoa in 1925 effected a merger with Duke interests on the Saguenay (that is, with the Canadian Manufacturing and Development Company, formed for the purpose of the merger), whose undeveloped water powers at the Lower Site passed to Alcoa. The Duke-Haskell plans were discarded. Duke and his associates received oneninth of the capital stock of the reorganized Alcoa and a place on the board of directors.[26]

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[24] *Ibid.*, p. 296.

[25] *Ibid.*, pp. 373-86.

ALCOA'S STRATEGY

Why was Alcoa willing to merge with Duke on these terms? Alcoa's Chief Engineer, James W. Rickey, had made a survey of the power sites on the Saguenay River for the company. In his report, in February, 1925, Rickey urged that Alcoa acquire the sites, which offered " the best opportunity I have ever studied for the development of a large block of cheap, continuous power which will be practically free from interruption due to ice troubles and/or low water ". He predicted that a Shipshaw development of 400,000 horsepower (primary) could be built in three years, and an added 360,000 horsepower could be constructed " when and as required " to bring the average capital cost down to $50 per horsepower. Rickey was confident that the remoteness of the sites from " big manufacturing centers " would prevent " public service demands " from recapturing the power from industrial use " for a great many years " or forever. Rickey expected that Alcoa could use some of the power to produce aluminum either in New York State to avoid the American tariff on aluminum imports, or at a plant site in Canada. Enough would be generated as surplus over Alcoa's needs to retail in eastern Quebec, Ontario, and New York State districts.

The transmission route of the planned power exports was designed to " form the nucleus of a ' Grand Power System ' " and to " provide the entering wedge for our developing the international section of the St. Lawrence since we could already be distributing a large block of power in Western New York and would be coordinated with the Hydro and Montreal power interests ". At the proper time Alcoa would proceed to " seek the right to develop the international section " according to a preconceived financial plan. Shipshaw and Ile Maligne were envisaged as great stepping stones to Alcoa control of the vast power resources of the International Section of the St. Lawrence with a potential of 1,640,000 kilowatts.[27]

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[26] Actually, 1/9 of the preferred, 3,412,600 common shares (1/9), and option to buy at $5 enough Alcoa common to raise the Duke participation in common stock to 15%. The market price of this stock was far more than $5 at this time. *Ibid.*, pp. 335, 339, 341.

By buying out Duke, Alcoa was securing control over the largest water power site in the Americas available for private development. Alcoa was eliminating the competition of another industrial giant resting on power resources surpassing Alcoa's own. The Upper Development on the Saguenay was made harmless to Alcoa by the inclusion of Duke within the Alcoa organization, although only Shipshaw, and not Ile Maligne, passed into Alcoa's hands. Further, Alcoa signed a ten-year contract for power from Ile Maligne in April, 1925. No power was delivered under this agreement, which was cancelled and replaced by another contract in 1926.[28]

Less than a year after Duke's death in the fall of 1925, Alcoa bought 53½% of the stock of the Duke-Price Power Company, which controlled the Upper Development. At this time Alcoa signed a 50-year power contract to receive from Ile Maligne 100,000 horsepower years of energy at $12 per h.p. This was apparently the payment for the stock.[29] Not only did this contract take up fully ¼ of the total developed capacity at Ile Maligne, but it invested the Duke-Price Power Company with a stake in Alcoa's industrial stability.

The power supplied under contract and available through Alcoa's domination of Duke-Price and its absorption of Shipshaw, was more than three times the total developed power previously owned by Alcoa, and would have sufficed to produce 550,000,000 pounds of aluminum a year, or 372,000,000 more than the total world production in 1924. Alcoa could not immediately develop or utilize the tremendous power flow at Shipshaw.

[27] *Leg. Doc. No. 89,* p. 115. (See footnote 9 above for full citation.)

[28] Brief for the United States, p. 350.

[29] Equity No. 85-73, Exhibits 262, 263.

While Alcoa already had cheap and ready power under its 1925 contract with Duke-Price, it was able by these new arrangements to gain long run control over power resources, thus adding to its ability to compete on world markets, and to exclude Duke's competition, whether alone or in conjunction with an independent like Haskell, from the aluminum industry of the Americas.[30]

At the Ile Maligne station on the Grand Discharge of Lake St. John, the first installation, " completed in 1925. . .consisted of 360,000 h.p.". By 1937 the installed capacity had been increased to 540,000 h.p.[31] The stock of the Saguenay Power Company (formerly the Duke-Price Power Company) controlling the Ile Maligne station, was transfered to Alted in 1928 when the latter was formed to hold Alcoa's foreign properties and to conduct Alcoa's foreign relations. Alcoa Power Company, subsidiary of Alcoa formed to hold Shipshaw, was retained by Alcoa until 1938 when, before the trial of the Government's anti-trust suit against Alcoa, it was sold to Alted and became the Aluminum Power Company. In 1941 Alted transferred this subsidiary to the Aluminum Company of Canada. One of the charges in the suit was that Alcoa had acquired Shipshaw to further monopolistic plans.

ALCOA FIGHTS FOR THE ST. LAWRENCE

Simultaneously with its activities in the Saguenay area, Alcoa was emerging as the chief figure in the Canadian-American power resources of the St. Lawrence River. For over two decades Alcoa sought to secure for itself and allied interests the right to develop the power potential of this area.[32]

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[30] "A purpose and an effect of said stock acquisition (of Duke-Price Power Company) were to enlarge the capacity of Aluminum Company for low cost production outside of the United States to operate as a further threat to dissuade European producers from interfering with Aluminum Company's ... monopoly of the United States market." Petition filed by the United States, Par. 97.

[31] Estabrook & Co., "Aluminium Limited", New York, April, 1944, p. 7.

[32] Leg. Doc. No. 89, p. 11. The project covers the International Rapids Section of the River between Ogdensburg and the International boundary line.

In 1920 an International Joint Commission began to investigate the proposed St. Lawrence project, and Canada and the United States made plans for a technical study by the newly constituted Joint Board of Engineers. In the same year, Alcoa subsidiaries applied to the new Federal Power Commission for licenses to develop the United States side of the International Section of the River. Alcoa owned the only existing power development in this Section, the St. Lawrence River Power Company at Massena. Early in 1921, the New York Water Power Commission was created with power to license private development of state-owned power sites.

> Almost immediately the General Electric-DuPont and Aluminum Company interests filed applications for licenses. In August of the same year the interests were merged into the Frontier Corporation with the Aluminum Company holding the dominant position.[33]

But the plans were thwarted by the hostility of the new Governor-Elect, Alfred E. Smith, who in 1922 blocked a long-term lease of the St. Lawrence resources to the Frontier Corporation. Encouraged by the favorable reports of the International Board of Engineers and Commission, Smith " demanded public ownership of St. Lawrence power and creation of a New York State Power Authority to develop the power ". Finally in 1926 the Governor was given " a practical veto " over the licensing of the State's power sites, by a constitutional amendment which was overwhelmingly ratified as the Governor was reëlected after campaigning on the power issue. The license application of the

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The river provides a head of 85 feet for power production. The original purpose of the proposed development was ocean navigation linking the Great Lakes to the Atlantic via the St. Lawrence. Governments involved include the Dominion of Canada, the United States, the Province of Ontario, and the State of New York. Of the total 1,640,000 kilowatts to be installed, New York gets 820,000, including 575,000 kilowatts of firm, continuous power. Industrial power would be available at the low figure of 1 mill per kilowatt hour. *Ibid.*, p. 115.

[33] *Ibid.*, p. 35.

Frontier Corporation was withdrawn after Smith threatened to challenge the license in the courts.[34]

NEW TACTICS

Public development, however, was stalemated as the Joint Board of Engineers failed to agree on a technical report. On the Canadian side, a fresh effort for private development of the Soulanges Rapids Section of the St. Lawrence was undertaken in 1927 by the Beauharnois Light, Heat and Power Company. The first Beauharnois syndicate, set up May 12, 1927, " eventually included " Aimé P. Geoffrion, now a director of Alted and then representing Alcoa's Canadian interests, and Frank P. Jones, associated in the syndicate with W. S. Lee, officer and director of the Duke-Price Power Company of which Alcoa had acquired majority stock control in 1926. Later a part of Jones' interest passed to Montreal Light, Heat and Power Consolidated. This Company, controlling " the largest existing development in the Soulanges Rapids Section," supplied power to the Alcoa plant at Massena.[35] It in turn was controlled by the Shawinigan Water and Power Company, which also owned a 20% interest in the Duke-Price Co., Ltd.

An international power consortium, in which Alcoa had direct and indirect interests, moved to develop Soulanges Rapids in Canada, after the Alcoa-dominated Frontier Corporation had failed to make headway in developing the United States side of the International Section.

The Canadian National Advisory Committee, set up to formulate government policy in relation to the proposed St. Lawrence development, reported in 1928, in favor of delay in developing the International Section, until the Soulanges power had been developed and marketed by the private interests. The Committee included persons associated with the power consortium. The view of the committee was accepted by the Dominion Government in a note to the United States. The publicly-owned Ontario Hydro-Electric Power System was, in consequence, " deprived of the opportunity to develop its own power resources in the St. Lawrence," and this " in the face of a rapidly growing power demand".[36] The Ontario System was forced to buy from private companies in Quebec, including the Beauharnois Light, Heat, and Power Company. The province of Ontario, by contracting for one-half of the capacity of the initial Beauharnois development, aided private investment in the Quebec section of the St. Lawrence River.

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[34] *Ibid.*, pp. 35-36.

[35] *Ibid.*, p. 37.

In 1929 the Niagara Hudson Power Corporation became " the dominant power interest in the State of New York ". " Alcoa and its associates transferred the Frontier Corporation to Niagara Hudson ". Alcoa received in exchange 10% of the stock of Niagara Hudson, and a directorship for Arthur V. Davis.[37]

Thus the aluminum-power interests were affiliated. At the same time, the public system of Ontario was flanked by the Shawinigan Falls system dominating Quebec and Niagara Hudson ruling New York. Summarizing the role of Alcoa in power, the New York State Power Authority comments:

> Alcoa has participated in every power development of importance available in the outflow of the Great Lakes-St. Lawrence basin. Where the Aluminum Company could get its way, the development went forward. Where the threat of public development assured the possibility of competition with its power and aluminum monopolies, the development was blocked.[38]

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[36] *Ibid.*, pp. 37-38.

[37] *Ibid.*, p. 39. The official date of the transaction was January, 1930. Part of the Niagara Hudson stock received by Alcoa was subsequently distributed to Alcoa stockholders as a stock dividend, in the ratio of one share of Niagara Hudson common for each share of Alcoa common held. *Moody's Industrials*, 1943, pp. 382, 384.

[38] *Leg. Doc. No. 89*, p. 41.

THE MODERN SHIPSHAW DEVELOPMENT

The second World War gave Alcoa's Canadian twin, Aluminium Limited (Alted), an opportunity to bring to fruition the old plan for a huge power development at Shipshaw, at the Lower Site on the Saguenay River, as part of a great integrated aluminum power production system in Canada.

The Chute-à-Caron power project was begun at the Lower Site in 1928, the year in which Alcoa's foreign properties were organized into Alted, a separate company controlled by Alcoa stockholders. By 1931 a dam was built and generators installed. An ultimate capacity of 430,000 horse power was attained.[39] Meanwhile, Alcoa had acquired a plant site at Arvida, in the Saguenay district, 3 miles from the power site. There an aluminum smelter was erected, and ingot production began in July, 1926. In 1937 a Bayer process alumina plant was erected at Arvida, which had previously relied on Alcoa's alumina plant at East St. Louis. Thus Arvida was shaped into an integrated system.

With the rearmament of the major nations of the world, Arvida found it desirable to increase plant capacity in 1938 and the first eight months of 1939 to 90,700 metric tons. The expansion was self-financed. Later the United Kingdom, consumer of 41.5% of Canadian aluminum exports 1926-39, requested increasing quantities of aluminum, requiring a series of expansions in production capacity. The British Government extended a loan to the Aluminum Company of Canada (Alcan), subsidiary of Alted and proprietor of Alted's Canadian assets, amounting to $29,900,000 on February 2, 1940. Finally the loan was increased to $55,600,000, covering capacity increases to 435,000,000 lbs., or 435% of prewar capacity.[40]

The loan was repayable in full only if the added capacity was used in full each year over a 20-year period, and was to be abated in interest and principal in proportion to the amount of the new capacity which lay idle any year. In addition, the United Kingdom spent $6,800,000 on extrusion and tubing mills at Kingston, which Alcan built for the United Kingdom and rented from it. The lease was described by the Canadian Minister of Munitions and Supply as " a hire-purchase plan " which will give Alcan title in twenty years.[41]

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[39] Fergus J. McDiarmid, "Canada's New War-Born Hydroelectric Giant", *Public Utilities Fortnightly*, April 29, 1943, p. 553.

[40] Kenneth R. Wilson, "The Truth About Aluminium, Ltd.", *The Financial Post of Canada*, July 24, 1943; Estabrook, *op. cit.*, pp. 6, 9.

By the midsummer of 1941, Alted had negotiated contracts with three governments—the United Kingdom, the United States, and Australia—requiring an ingot capacity at Arvida of 1,100,000,000 lb., and therefore demanding an estimated added investment of $117,000,000.

To service the expanded production, the great Shipshaw power project, planned by Alcoa as far back as 1925, was rushed to completion behind a wall of secrecy. The old Chute-á-Caron installations were deposed to a standby position, and two generators were transferred from the Chute-à-Caron plant to Shipshaw. Five great dams were built, directing the entire flow of the Saguenay River into a new channel hewn out of solid rock. Concrete-lined tunnels of thirty foot diameter were cut through rock to carry water down a two-hundred foot drop to the turbines. Storage dams were built on tributaries of the Saguenay, to stabilize the water flow throughout the year. Planes flew men and materials to Lake Manouan, wilderness storage reservoir of the Shipshaw power plant. Temperatures often dropped to 25-35° below zero. Sixty-two lives were lost in the course of two winters' work. But the work proceeded to completion in the fall of 1943.[42]

ROLE OF THE UNITED STATES IN FINANCING SHIPSHAW

Both Shipshaw and the expansion of Arvida ingot capacity were financed by the funds of the foreign governments in need of Canadian aluminum, and in particular by the United States.

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[41] House of Commons Debates, Official Report—Daily Edition, March 23, 1943, p. 1487.

[42] McDiarmid, *loc. cit.*, pp. 554-5.

The provision of funds took the form of advance payments of $93,000,000 on aluminum deliveries. The share of the United States in these advances was $68,500,000, advanced interest-free (interest would amount to $2,500,000). The American advances were being paid off by deducting 5c. a pound from the sale price of aluminum sold and delivered to the United States. In addition, " lines of credit " were established at Washington, " available to the Company in installments as the metal is delivered ", and amounting to $34,250,000 (U. S. funds) and $5,000,000 (Canadian funds).[43]

The American contracts with Alcan, negotiated through the Metals Reserve Company in 1942, called for 1,370,000,000 lb. of aluminum. The price agreed on was 15c. a lb. on 1,096,000,000 lb. for direct use by the United States, and 17c. on the rest, which was destined for Lend-Lease.[44] Not until the entire aluminum order is delivered will the $68,500,000 of advances be paid off.

By a special Order in Council dated December 31, 1942, the Canadian government freed for use as capital the revenues coming to Alcan from Allied advances. That is, the Privy Council refrained from subjecting a substantial part of the gross revenues of Alcan to income and profits taxes. The Order in Council permitted Alcan to amortize at an accelerated pace its war-built reduction and power facilities, at the rate of 5½c. per lb. of aluminum delivered to the Allied governments. The company was enabled to write off against its taxable profits in four and a half years 100% of the $117,000,000 estimated cost of aluminum plant expansion, plus 5% ($5,850,000) extra for contingencies. It was also permitted to write off 60% of the estimated $62,500,000 cost of the Shipshaw electric power project, plus 10% for contingencies. Dispensations on other Alcan investment brought the total accelerated depreciation of plant up to $177,360,000.[45]

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[43] Estabrook, *op. cit.*, p. 11.

[44] *PM*, March 22, 1943.

[45] Estabrook, *op. cit.*, p. 12; House of Commons Debates, May 14, 1943, p. 2731.

Thus not only was the bulk of the wartime expansion of Alcan facilities financed by the various Allied governments in the form of loans and advances repaid out of earnings, but the greater part was to be written off in a short space of time, in a period of high wartime taxes on corporate income. Furthermore, escalator clauses in the contracts permitted price rises sufficient to allow a write-off of the expansion at 5.5c. a lb. out of earnings even if labor and transportation costs should increase, i. e., a profit margin was guaranteed by mandatory additions to the base price. The escalator addition in 1942 was 3.51c. a lb.; in the first half of 1943 it was 5.75c. a lb.[46]

Mr. C. D. Howe, Minister of Munitions and Supply, offered a public defense of accelerated depreciation as good policy in cases where wartime expansion extends capacity beyond expected peacetime requirements.[47] He pointed out that if Alcan actually did find the postwar value of its new plant to be greater than now supposed, Alcan earnings would then be fully subject to taxation without allowance for depreciation, and the public would benefit in lower prices. (Of course it is likely that changes in tax rates in the interim would confer on Alcan a net savings in long-term tax contribution.) Governments in need of war production are the rightful bearers of risk on war investment. Accelerated wartime use of productive properties is another justification of accelerated depreciation allowances. High wartime construction costs justify Alcan's apprehension about a residue of investment cost to amortize in uncertain postwar years. (Shipshaw was built at a cost of $62,500,000, although the estimated peacetime cost of doing the work was only $39,000,000).[48]

Accelerated depreciation accounting wrote off more than ⅔ ($64,560,000) of Alted 1943 profits before all depreciation and income and excess profits taxes. The taxes took only $14,360,-

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[46] Estabrook, *op. cit.*, p. 17.

[47] House of Commons Debates, March 23, 1943, p. 1483.

[48] *Ibid.*, p. 1485.

000, and $13,000,000 went to earned surplus. Between 1940 and 1943 Alted was able to amortize $123,606,000 of war investment by special dispensation.[49]

IMPLICATIONS OF SHIPSHAW

While some of the general arguments for special treatment are applicable to Shipshaw, it is clear that Alcan has been able to push to completion a long-desired power development under extremely favorable circumstances. With the aid of its added capacity to reduce and fabricate aluminum, Alcan has expanded and consolidated its producing strength in an integrated system. This will be the base for postwar operations of tremendous magnitude envisaged by Alcan in soliciting subscriptions to a new stock issue in 1943.[50] Therefore the claim of postwar uselessness as a justification for special consideration is weakened.

INCONSISTENT PUBLIC POLICY?

Broader implications of the way in which Shipshaw was built and paid for are of public interest. The source of Shipshaw funds is the advances and loans of the United States supplied to a private enterprise for power construction under unprecedented conditions. No control over the project is retained by the United States. Shipshaw, lying outside the United States, escapes the jurisdiction of the Federal Power Commission with which Alcan had already come into conflict over the issue of eventual recapture of Southern hydro projects. The government of the United States retains no title to the plant it has brought into being through financial contributions. This runs counter to the practice of the Defense Plants Corporation, instrument of Federal financing of wartime industrial investment within our borders. (The Metals Reserve Company, which negotiated the Canadian contracts for the United States, is, like the DPC, a subsidiary of the Reconstruction Finance Corporation.)

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[49] Estabrook, *op. cit.*, p. 15.

[50] See statement of S. H. Knowles in House of Commons Debates, May 14, 1943, p. 2730. Mr. Knowles charged that Alcan issued preferred shares for the first time in its history to diffuse ownership among small investors and thus enlist public opinion in support of Alcan.

The lack of control retained by the United States is incongruous with the acknowledged fact, foreseen by Rickey in 1925, that the future of Shipshaw affects vitally the stake of this nation in the St. Lawrence River, as well as other public power projects.

SHIPSHAW—A BLOW TO PUBLIC POWER

Meanwhile, construction of public projects and transmission lines in the United States was curtailed by the Office of Production Management and by the War Production Board on grounds that a shortage of essential materials and generators prevented their completion. Four million kilowatts scheduled for utilization in 1944 or later were cancelled, about half of this amount being public construction at Grand Coulee, TVA, Shasta and Keswick Dams in California, etc.[51]

Although about 500,000 horsepower in Federal projects east of the 100th meridian was halted, it was the blow to Western public power that was most keenly felt. Over 1,000,000 horsepower in western projects previously authorized by Congress was suspended by the WPB. These states are aware that their industrial future is closely bound to the provision of cheap power. The location of more war production in the west has been urged by western spokesman in Congress as the prelude to postwar growth of the Pacific producing area. Furthermore, western projects were linked with broad programs for aircraft production and for flood control, reclamation, and irrigation—all leading towards greater food production on the Pacific coast—and to wartime electrometallurgical industries.[52]

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[51] 78th Congress, 1st Session, House of Representatives, *Hearings before the subcommittee of the Committee on Appropriations on the Interior Department Appropriation Bill for 1944*, Part 1, Washington, 1944, pp. 359-64.

[52] *PM*, March 22, 1943.

Advocates of public power fear the postwar consequences of the grant of financial resources to Shipshaw. Free of all capital charges for interest and amortization on 60% of its cost, Shipshaw will be able to undersell public power in Ontario and to export power to the United States. Production costs at Shipshaw are estimated at 1-2 mills per kilowatt hour, inclusive of capital charges and a profit margin.[53] The possibility exists that Shipshaw's cost advantage may hinder public international development of the St. Lawrence River in so far as overlapping markets of the two power-producing areas make it more difficult to utilize both systems fully. The location of new industries in Canada as a result of our Federal subsidy will be a poor recompense for the financial contribution of Americans, especially as such industries are expected to be specifically competitive with those that New York and other states hoped to attract by power development and abundant native resources.[54]

The secrecy surrounding the Shipshaw project and its financial basis, although dissipated in the spring of 1943, has naturally given rise to speculation as to the way in which negotiations were conducted. Minister Howe denied that the Canadian Legation (afterwards elevated to Embassy) in Washington participated in the negotiations. M. J. Coldwell, president of the Cooperative Commonwealth Federation, found the denial " very difficult to believe ".[55] As Coldwell pointed out, Mr. Leighton McCarthy, appointed Canadian Minister to the United States in February, 1941, and later raised to Ambassador, is a vice-president and director of Alted. Until January 1943 he was a vice-president and director of Alcan also. He was replaced in the latter offices by J. F. Van-Lane, secretary of McCarthy and McCarthy, the Ambassador's Toronto law firm. For almost 30 years Leighton McCarthy was counsel for Alcan. He was also vice-president and director of the Saguenay

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[53] McDiarmid, *loc. cit.*, p. 555.

[54] *Leg. Doc.* No. 89, p. 20.

[55] House of Commons Debates, May 14, 1943, p. 2727.

Power Company, Alcoa's old subsidiary in the Shipshaw-Arvida area.[56]

POWER AND POSTWAR POLICY

Because of low power and labor costs, Shipshaw will be in an advantageous position to meet competition from any DPC aluminum plants in the United States which might pass into independent hands after the war. Alcan will indeed be able to lead the world in aluminum production. With the aid of the cheap Saguenay power, Alcan, it is predicted, will cut aluminum prices below those of copper, and aluminum will replace gold as the chief item in the Canadian balance of payments.[57] While this potential development would be a boon to aluminum users the world over, it might remain merely potential, or at least might not be brought to full realization for some time, if Alcan should be able to take a leading part in forming a new world cartel.

As the Canadian northland is opened to development by the Alaskan highway and by air transport, the terms on which this " last great frontier of North America " is opened become significant. Two principles compete for selection: Shipshaw, representing public subsidy for uncontrolled private enterprise, akin to early American railroading; and TVA, standing for public enterprise in power for the benefit of consuming industries and households. So far the Shipshaw principle has won out. For Canada, this has meant acquiescence in a policy of private use of natural resources, with much of the distributed portion of corporate earnings drained off to the leading Alcoa-Alted stockholders in the United States. This situation will not promote good Canadian-American relations. Representative John M. Coffee of Washington has asked why, if it was necessary for the United States to subsidize Canadian power, we " didn't make it a gift to the good people of Canada, and not to the aluminum trust which has done its best for two generations to stifle power development on both sides of the American-Canadian Border? "[58]

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[56] *Ibid.*, and *PM*, May 16 and 19, 1943. One of McCarthy's activities 1921-6 was lobbying on behalf of the Frontier Corporation, Alcoa's spearhead until 1929 in the drive for private exploitation of St. Lawrence power. His work included personal conferences with Canadian Premier Mackenzie King, officials of the Province of Ontario, members of the Canadian Parliament and of the Canadian government. His fee for these efforts to secure special privileges for Alcoa and to obstruct government power projects, totalled $18,686.34. 70th Congress, 1st Session, Sen. Doc. 92, Part 72, Utility Corporations, Letters from the Chairman of the Federal Trade Commission transmitting in response to Sen. Res. No. 63 a monthly report on the electric power and gas utilities inquiry together with exhibits in response to S. Res. No. 112, No. 72, Niagara Hudson River Corp. and American Gas & Electric Co. group, Filed with Secretary of Senate December 18, 1934, Washington, 1935, p. 180.

[57] McDiarmid, *loc. cit.*, p. 557.

Power is so important in the making of light metals that aluminum monopolies the world over will be severely threatened by the opening of new power sources outside their control. Switzerland, although devoid of bauxite, gained early preëminence in aluminum production through plentiful and intensely developed power resources. India bids fair to be the future example of the essential relation of cheap developed power to efficient aluminum manufacture, especially as she possesses ample bauxite to support a light metals industry. Other bauxite sources may repatriate their aluminum industries on the basis of domestic energy. Assistance is already granted to the American aluminum industry by the supply of low-priced power through government-built power projects. Aluminum production may well depend in increasing proportions on this type of aid. Government power projects to supply independent aluminum producers in the United States and elsewhere may provide a partial answer to the problem of aluminum monopoly.

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[58] *PM*, March 17 and 28, 1943.

CHAPTER V

ALCOA AND THE EARLY CARTELS

CARTEL activities have been defined by Dr. Corwin Edwards as " arrangements among business enterprises engaged in the same type of industry to avoid some or all forms of competition. Cartel activities are designed to maximize the profits of participants by directly or indirectly maintaining prices at the level of greatest net return." [1] International cartels rest firmly on domestic market control without which local competitors can nullify international cartel policy. Conversely, regulation of foreign relations is essential to protect a domestic monopoly against international competition, unless enough protection is afforded by tariffs and shipping costs.

Dr. Edwards' definition stresses the main purposes of cartels rather than the form of organization. This is useful, as certain " orthodox " writers define the cartel narrowly to include only a marketing unit determining prices and production, and exclude patent pools, licenses, and intercorporate relations.[2] The similar effects and growing complexity of patent ties and of other forms of economic agreements, have led Edwards to classify cartel organization into three types. The first is the *association,* a joint body of producers in different countries, agreeing formally to fix prices, production, sales, and exports, allocating markets, redistributing profits, or even marketing the product jointly. The cartels in the aluminum industry have taken this form. The second form is the *patent licensing agreement* which confers monopoly rights in a certain area under the patent laws of most countries. Such agreements arrange for mutual and exclusive sharing of results of research, under

[1] 78th Congress, 2nd Session, Senate Committee Print, Monograph No. 1, *Economic and Political Aspects of International Cartels,* A Study Made for the Subcommittee on War Mobilization of the Committee on Military Affairs, United States Senate, pursuant to S. Res. 107, Washington, 1944, p. 1.

[2] Ervin Hexner, " International Cartels in the Postwar World ", *Southern Economic Journal,* Vol. X, No. 2, October, 1943, p. 121.

conditions defining the geographical fields recognized as the private domain of particular parties to the agreement. In addition, prices, quantities of sales, channels of distribution, and other business policies may be covered by a patent agreement, and third parties may be permitted to share restricted rights. Because of this feature, patterns of control may be discerned by scrutinizing all comprehensive agreements engaged in by various firms, even if all the firms have not entered into each agreement. The patent agreement was used in the magnesium industry, as related in Chapter VIII.

The *combine,* the third form of cartel, controls international markets " by uniting competitors under common ownership or management."[3] A small combine may then engage in patent agreements or be a part of a " pure " cartel association, so that the combine is not usually the sole vehicle of cartelization in an industry. While combinations of competitors are frequent in modern industry, they have not usually been classified as cartels, on the theory that only contracts among legally independent firms qualify as cartel relations. However, a large modern firm, which produces a variety of more or less related products, may set up a joint corporation with a competitor in respect to only one of its products, keeping independence in other parts of its business. The chemicals-metal trust I. G. Farbenindustrie, together with the Aluminum Company of America, jointly set up an American company to hold their magnesium patents.

Informal intercorporate relations based on personal ties are included by Edwards in the " combine " class. He cites the fact that not only is the stock in the Canadian company, Aluminium Limited, controlled by the same three families which control Alcoa, but the president of Aluminium Limited is the brother of the chairman of the board of Alcoa.

EUROPEAN BACKGROUND OF ALUMINUM

The technological and commercial development of aluminum has been international in scope, and the dispersion of the industry favored the setting up of world cartels. The Danish chemist Hans Oersted in 1825 isolated aluminum for the first time, and by 1845 the physical properties of the metal were determined by Friedrich Wöhler, a German. Napoleon III patronized the manufacture of aluminum, hoping to make the French army more mobile through its use. He commissioned the French chemist, Henri Deville, to produce the metal cheaply, and in 1856 a small metallurgical plant conducted operations briefly at Javelle, France. The sodium method employed by Deville was commercially used to produce aluminum for sale at $5 a pound.[4]

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[3] *Economic and Political Aspects of International Cartels,* p. 7.

Other countries took up the problem of finding an economical method. The development of the dynamo in the 1870's made possible cheap mass production, but some years elapsed before suitable reagents and equipment for electrolytic reduction were developed by Charles Bradley and Charles Hall in the United States and by Paul Héroult in France in 1886. No single country could claim authorship of all the various advances in productive methods. The most important enterprises grew up in France, Germany, Switzerland, England, and the United States.

In France the original Deville method took root at Salindres in 1857, where production went on until the new electrolytic method was seen to be better.[5] Héroult had been rebuffed in France, but found welcome in Switzerland at the iron foundry owned by J. G. Neher Sons, where experiments with cryolite (an aluminous ore) had been going on. A new company was formed in 1887 to take over the Héroult patents for all countries but France, under the name of Sweitzerische Metallurgische Gesellschaft, and to build a furnace producing aluminum bronze. In 1888 the Allgemeine Elektrizitäts Gesellschaft, German power trust, came into the enterprise with capital for expansion, and the Aluminiumindustrie A. G. (Neuhausen) was formed, acquiring title to the previous company's assets. It has since retained its importance as a leading world producer of aluminum.[6]

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[4] *Commodities in Industry*, Commodity Research Bureau, New York, 1940. pp. 41-44.

[5] Donald H. Wallace, *Market Control in the Aluminum Industry*, Cambridge, 1937, p. 87.

Rights under the Héroult patent in France were acquired by the Société Electrométallurgique Française at Froges, the first French firm producing aluminum commercially by electrolysis. Meanwhile, the Salindres plant passed into the hands of the Péchiney interests in 1896, and the Cie. de Produits Chimiques d'Alais et Camargue was formed. Unable to get rights to the Héroult process, the latter firm absorbed another aluminum company, thus acquiring rights under French patents issued to the American, Charles Hall, for a similar process. The companies of Froges and Alais were merged in 1921 under the name of Cie. de Produits Chimiques et Electrométallurgiques d'Alais, Froges, et Camargue; this company has produced nine-tenths or more of French output. Another French concern, Société d'Electrochimie, d'Electrométallurgie, et des Acièries Electriques D'Ugine, founded in 1889 to conduct an electrochemical business, also expanded as an aluminum producer. In 1911 the Péchiney and Ugine interests united to form a selling association, L'Aluminium Français, which acted for both groups on domestic and foreign markets.

After several rather ineffective attempts in England to produce aluminum by the Deville method, a modern aluminum industry began when the British Aluminium Company Limited (BACL) was founded in 1894. From the Swiss concern it bought rights under the Héroult patents, and expanded rapidly within the United Kingdom (especially in Scotland) and in power-rich Norway.

Until the First World War Germany was getting aluminum mainly from the Swiss company, which had also set up the first aluminum plant in Germany at Rheinfelden in 1897. But during the World War, under German government sponsorship, the Vereinigte Aluminiumwerke (VAW) was established in 1917 as the first important modern plant in Germany. Griesheim Elektron Company aluminum works and those of Metallurgische Gesellschaft (Metallbank affiliate) were included in the VAW organization. Griesheim interests, which also pioneered in magnesium production, withdrew in 1919 and were absorbed by I. G. Farbenindustrie in 1925. The Bitterfeld works owned by Metallgesellschaft (the changed name of Metallurgische Gesellschaft) and by I. G. Farben, was the only other significant aluminum producer in Germany up to World War II.

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[6] "Aluminium Neuhausen, Switzerland", *Moody's Economist Services, Ltd.*, December 21, 1939.

In the United States the Cowles Brothers of Cleveland began production of aluminum alloys in 1885, and in 1892 of aluminum itself under the newly issued Bradley patents. Meanwhile the Pittsburgh Reduction Company (known as the Aluminum Company of America after 1907), was incorporated in 1888 to operate under the Hall patent. After long litigation with the Cowles Company (described in Chapter III), PRC acquired a monopoly in 1903 which it maintained until 1940.

Having briefly sketched the international spread of aluminum production, we shall now see how cartel relations aided the growth and stabilization of the Alcoa monopoly.

Agreements with the foreigners to protect Alcoa's home market were essential to Alcoa's security. Aluminum is a standardized commodity which can be produced in widely separated places, so long as cheap power is present, bauxite is available, and transportation facilities are adequate. The metal can be shipped over long distances at relatively low cost. Therefore no domestic monopoly can be securely maintained without establishing definite relations with producers of other lands. Cartelization of aluminum producers on a world scale has been further encouraged by the small number of producers in each country, and by the weight of capital investment in bauxite mines and power, as steady and large production is required for low unit costs. Aluminum cartels have nourished, and been nourished by, national monopolies. Except in the earliest research days, aluminum production has been organized on a large scale.[7]

The American industry has had a broader domestic market and probably a more secure home monopoly than the other leading aluminum companies of the world, and has figured as an important, and indeed dominating factor in international agreements. Chapters V and VI retrace the history of the participation of Alcoa in international affairs, and present the mechanisms and objectives of the world control systems in which Alcoa has played a vigorous part. The strongly worded description by the Department of Justice of the cartel activities of Alcoa since 1896 may serve as a challenging introduction to this phase of Alcoa's monopoly-building:

> The evidence discloses ... *one* gigantic and all-embracing conspiracy, which, with Alcoa as its nucleus, has been in operation intermittently from 1896 to the present. This conspiracy has passed through many vicissitudes during its 44 years of existence; it has ebbed and flowed in strength and effectiveness ... discarded and regained units of its membership ... survived periods of depression and prosperity ... passed through one great war to emerge unscathed and with new vigor; and today it is temporarily submerged in a new great war. This conspiracy has been a hardy perennial indeed, and not a little credit for its persistence ... must be accorded to the omnipresent figure of Arthur V. Davis.[8]

FIRST DAYS OF THE HARDY PERENNIAL—1895-1915

In 1896, the Pittsburgh Reduction Company (PRC), only eight years old, entered into an agreement with the Swiss Aluminiumindustrie A. G. (Neuhausen), as yet its only important rival in the world market. The agreement, negotiated with the Neuhausen representatives by Arthur V. Davis, president of the PRC, when he went to Europe in 1896, reserved to the PRC the American market and to the Swiss, the markets of Germany, Austria-Hungary, and Switzerland.

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[7] Alfred Plummer, *International Combines in Modern Industry*, New York, 1938, p. 80.

[8] Equity No. 85-73, In the District Court of the United States for the Southern District of New York, United States of America v. Aluminum Company of America, et al. Brief for the United States, December 2, 1940, p. 640.

THE 1901 CARTEL

The first cartel directly including the other European producers was set up in 1901. On June 19, 1901, the PRC was invited by the British Aluminium Company to attend a meeting for the purpose of forming an agreement to avoid future price competition. After several months of negotiation, a cartel was formed on November 2, 1901. Parties to the agreement were the Swiss, British, and two French companies, Société Electrométallurgique Francaise (Froges) and Compagnie de Produits Chimiques d'Alais et Camargue, all operating under the basic patents or under licenses, and the Royal Aluminum Company. The latter, a wholly-owned Canadian subsidiary of PRC, was formed two days before the agreement was signed, presumably for the immediate purpose of signing in the place of the PRC. The 1901 cartel, which embraced the producers of 90 per cent of the world's aluminum, reserved the United States market exclusively to Royal. Each of the foreign producers likewise got exclusive rights to its domestic market. Outside these "closed markets," sales were allotted by quotas (Royal got 21 per cent of the total) and Neuhausen, source of 33⅓ per cent of the world output, was made selling agent for the cartel. All sales prices were fixed by the cartel, and the approval of the association was required for sales below the fixed price. In order to prevent aluminum sold in the closed markets from being resold in the open markets, prices in the closed markets were fixed at 1c a pound minimum above the open market price. A governing committee to manage the prices and operations of the cartel was organized. Although the PRC was not a signatory to the cartel agreement, Royal, through Arthur V. Davis, formally undertook responsibility for the acts of PRC and appointed an accountant having access to PRC records.[9]

In 1902, following a statute forbidding the use of " Royal " in Dominion trade names, the subsidiary was replaced by the Northern Aluminum Company, identical with Royal in all but name. Through Northern, PRC took part in cartel meetings and price-fixing activities, and benefited by the exclusive control of its domestic market.

The European price of aluminum rose from 2.5 francs per kilogram in 1901, before the cartel was formed, to 4.35 francs in 1905 (i. e., from 21.9c to 38.1c a pound in United States currency at then prevailing exchange rates). PRC's schedule price, however, stayed constant at 33c from 1898 to 1904 (possibly showing that it had been set at the point of maximum profit under the protection of patents and tariff as described in Chapter X, and was not influenced chiefly by the cartel).

BREAK-UP OF RELATIONS

The 1901 agreement expired in 1906, and the parties agreed to renew it in effect through a new association formed April 5, 1906. As previously, the world was divided into open and closed markets. The United States was allotted to Northern, which guaranteed that PRC would prevent re-export in fabricated form of aluminum which it sold in the United States. This pledge was secured by a deposit of 250,000 francs ($48,250).[10] The cartel broke up on September 30, 1908, although it was formally to expire on December 31, 1911. Owing to the expiration of the basic patents and to the attractively high prices set by the cartel, outside enterprises had mushroomed up in Europe. The British and French companies disagreed with the high-price policy championed by Arthur V. Davis and the Swiss, and invaded the American market in the next three years. Under the immediate stimulus of a tariff reduction, imports of aluminum ingot into the United States, only 113,755 pounds in 1908, rose to 12,386,897 pounds in 1910. To meet competition, Alcoa (so named after January 1, 1907) cut its schedule price progressively from 38c in 1907 down to 22c in 1910 and 20.3c in 1911.

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[9] *Ibid.*, pp. 648-50.

[10] *Ibid.*, pp. 650-51.

Anxious to salvage some protection out of the remains of the 1906 cartel, Alcoa (through Northern) made an agreement with the Swiss company, covering ingot and various semi-fabricated products, effective October 1, 1908, and terminable at six months notice after January 1, 1910. This contract specifically reserved to each party its closed domestic market. Fixed percentage shares in other markets were agreed on and prices were to be equalized by monthly payments between the parties.[11] The 1912 consent decree enjoined this agreement, but it had already been cancelled on February 17, 1912, after the Department of Justice began its first investigation of Alcoa.

THE 1912 AGREEMENT

Following an abortive agreement of April 28, 1912, covering the major European firms, a new cartel agreement was finally signed on June 10, 1912. Not only the participation of Northern in this cartel, and the personal activity of Arthur V. Davis in negotiating the new world agreement, but the previous invasion of the American market by European imports made it likely that Alcoa was eager to re-establish its home monopoly through a new market stabilization. The 1912 cartel again divided the world into open and closed markets and authorized periodic setting of a standard selling price. The agreement prohibited trading with, or owning any interest in, outside companies. This last was a new feature, repeated and elaborated in the Alliance Foundation agreement of 1931. (See Chapter VI.) The 1912 contract specifically excluded the United States from the sales control, and therefore was not enjoined by the 1912 consent decree signed by Alcoa. (See Chapter X, p. 238.) However, Northern, which was a party to the agreement, made all sales of

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[11] *Ibid.*, pp. 652-53.

Alcoa aluminum outside the United States at this time, and these sales were affected by the cartel.[12] The parent company arranged the 250,000 franc deposit required of Northern by the Association.

Meanwhile, the price of imported aluminum in the United States rose from 16½-17c (exclusive of duty) in 1911, to 19.58c in April, 1912, and was up to 26.46c by the end of the year. In this rise the cartel may have played the major part, although the sharp price fall which followed in 1913, and the rise in aluminum imports, would indicate that the cartel was not the strongest factor influencing prices at all times, or the only factor affecting foreign sales in the United States.[13]

THE CASE OF SOUTHERN ALUMINIUM

Originally conceived as a joint production venture of the European cartel members and the Northern Aluminum Company, the Southern Aluminium Company was incorporated in New York in 1912.[14] By pointing to the existence of an independent firm in the industry as an answer to monopoly charges, Alcoa perhaps hoped to temper the severity of the anti-trust consent decree which the Government was negotiating at that time. The particular concession sought and obtained by Alcoa, it is suggested by the Department of Justice, was permission for Northern to join in the 1912 cartel.[15] This may have been the reason why the corporation was finally organized without Northern participation, the French having 90% control, and the Germans, 10%.[16]

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[12] U. S. *v.* Aluminum Co. of America, et al., 148 Fed. (2) 416 (1945), October Term, 1944, Docket No. 144, Brief for the United States, p. 287. (Hereafter cited as Appellate Brief.) (Compare with the formal allocation of Alcoa's foreign sales to Aluminium Limited in 1928, described in Chapter VI.)

[13] The price fall was apparently the result of expanding domestic and foreign sales here to meet a growing demand, of the lower rates of the Underwood tariff in 1913, and of the onset of depression late in 1913.

[14] Equity No. 85-73, Exhibits 1011, 1121.

[15] Appellate Brief for the United States, p. 123.

[16] Equity No. 85-73, Brief for the United States, p. 243.

Northern joined with Alcoa, Southern Aluminium, and the Société Génerale des Nitrures (controlled by L'Aluminium Français) in October, 1912, to set up a corporation in the United States for the exploitation of the Serpek process in the Western Hemisphere. The Serpek patents for the simultaneous production of aluminum, ammonia, and nitrates were owned by the Société Générale des Nitrures. The proposed new corporation, to be controlled by Northern and Alcoa through an investment of more than $3,000,000 in stock, was known as the American Nitrogen Company.

According to the Government's petition in 1937,

> The purpose and effect of said contract [setting up the American Nitrogen Company] were to prevent the manufacture of alumina under said patents by others in the United States and Canada, and to create an interlocking interest between Aluminum Company and said French Aluminum Company through their joint operations in the production of alumina, and thereby suppress imports into the United States of aluminum and aluminum products by said French Aluminum Company. The manufacture of alumina under said patents proved to be impracticable, and said contract was therefore canceled by the parties in 1920.[17]

The American Nitrogen Company was to supply the alumina needs of Southern Aluminium for three years, and thereafter was to supply all the participants according to the size of their investments. As some delay was expected, Arthur V. Davis offered to supply Southern with alumina needs for 1913, 1914, and 1915 from the East St. Louis plant of Alcoa. This unusual offer was confirmation of the close relations of the two companies, as shown also by Davis' willingness to consider the Serpek patents merely as " the means of an alliance such as we now have and such as I hope will long continue." [18]

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[17] Equity No. 85-73, Petition Filed by the United States, April 23, 1937, Paragraph 91.

[18] Equity No. 85-73, Exhibits 563, 564.

The Southern Company bought partly developed power sites on the Yadkin River in North Carolina in 1912, and began to build a dam, power plant, and aluminum works. The intervention of the war cut off the company from European technicians and capital funds, and the company was forced to suspend operations in October, 1914. It was unsuccessful in securing outside financing from American capitalists (a tribute, perhaps, to Mellon prestige), and finally, after long negotiations, was sold to Alcoa in August, 1915. Alcoa was to pay $6,990,627 for the properties and other previous expenditures of the corporation, but this sum was reduced by the resale of $624,500 of equipment to L'Aluminium Français.[19] The equipment was not adaptable for use by Alcoa, which would not permit its use within the United States. The corporation was dissolved and its assets sold to Alcoa in liquidation.

The purchase provided Alcoa with new capacity, in an unfinished state, to be sure. It also protected the French interests against a loss on their venture, and served to build harmony between Alcoa and the French. And, finally, it removed from the market an aluminum enterprise which might have fallen into the hands of a competitor.

The 1912 cartel was formally suspended on January 23, 1915. A rapid expansion of capacity followed in all the belligerent countries.

> The advent of the first World War not only made it extremely difficult for the 1912 cartel to function effectively, but, as a practical matter, made the cartel itself unnecessary. A producer of an essential war material, entirely irrespective of his attitude toward the anti-trust laws, had no incentive to engage in activities designed to fix prices and limit production during a war.[20]

The growth of capacity in Europe, particularly in Germany, forced Alcoa to adopt a new strategy to maintain and aggrandize its position in the postwar market.

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[19] Equity No. 85-73, Exhibit 74; Brief for the United States, p. 242.

[20] Equity No. 85-73, Brief for the United States, p. 772.

POST-1918 SETTING OF CARTEL DEVELOPMENT

After 1918 cartel activities were basically affected by general economic and political developments. While the economic interdependence of the nations of the world was continually growing, the lack of official machinery for harmonizing international economic relations, and the hostility of the United States towards attempts to set up such machinery, left a vacuum in foreign economic relations which was filled by the action of private business. Private international treaties were made by businessmen who, lacking any official policy to guide them, used as guides to action " immediate self-interest and profits narrowly pursued ".[21] Monopoly profits at home were protected by the elimination of international competition; markets were divided, prices, production, and investment were controlled, and the use of new materials, processes, and products was regulated.

While American businessmen were governed by the private motive of monopolistic protection and restriction, the complexion of the agreements and their political results were affected by the drive of the German cartel partners of the Americans. German combinations were strengthened by the expansion of production during the first World War, by domestic and foreign loans and subsidies, and by the effects of the inflation on their competitors. The German business groups wanted to recapture and expand their prewar markets. Increasingly, too, they used their international economic power to build up strong war industries at home (often with the aid of American technology) and to disarm their proscribed victims abroad by cartel restrictions on production. They were enabled to do so by the monopolistic tendencies in the United States, France, Britain, and elsewhere.

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[21] 78th Congress, 2nd Session, Subcommittee Report No. 4, *Cartels and National Security, Report from the Subcommittee on War Mobilization to the Committee on Military Affairs,* United States Senate, pursuant to S. Res. 107, November 13, 1944, Part 1, Findings and Recommendations [Kilgore Report], p. 4.

In the United States, new improved technology in the electrical, chemical, automotive, and petroleum industries, holding the promise of expanding markets and consumption, was not fully used, because of fear that existing control would be risked in an international competitive struggle. Trading their chance at broad markets for security of control, a number of American businesses, behind high tariff walls, compromised with the Germans to protect home markets, and agreed to limit production capacity and the manufacture of new products.[22]

Over a period of six or seven years, beginning in 1919, Alcoa systematically expanded its foreign investments in aluminum production, fabrication, and sales enterprises, in power facilities, and in bauxite deposits. With these potential threats to the domestic markets of Alcoa's competitors, Alcoa gave silent warning of retaliation to any interlopers in the North American market. Alcoa's foreign interests did not seriously "bore from within" behind the tariff walls of trade rivals as did the many foreign subsidiaries of I. G. Farbenindustrie, German chemical trust. But in the case of Alcoa, the domestic market was large enough to constitute a chief prize in the international rivalry, which was not true for the export-minded I.G. Some of Alcoa's investments were joint participations with British, French, and Norwegian interests, and served to enhance and develop community of interests among the oligopolists. In other instances, notably that of the Norsk Aluminum Company, Alcoa bought out a foreign competitor.

Simultaneously with the policy of foreign investment, Alcoa pursued an informal, unwritten understanding with the European cartels which were formed in the aluminum industry after 1922. The Europeans tended to follow Alcoa's price leadership in the American market and at times denied large purchases to American consumers wishing to escape Alcoa's monopoly of domestic supply, although they exported some of their production to the United States despite Alcoa's displeasure.

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[22] *Ibid.*, pp. 4-6.

FOREIGN ACQUISITIONS

In Canada, by 1928, Alcoa had acquired aluminum smelting plants at Arvida and Shawinigan Falls, fabricating plants at Toronto and Shawinigan, power generating stations and an undeveloped power site on the Saguenay River, two private railways, docking facilities on the Saguenay, and transmission lines.

In England Alcoa owned only a small sales subsidiary, the Northern Aluminium Company, Ltd., and 10 per cent of the stock of an old customer, the Birmingham Aluminium Casting Company, Ltd. In France Alcoa owned an administrative and holding company, Alcoa de France, Forces Motrices du Béarn, organized in 1925 to build a hydroelectric plant and make aluminum for the French market, Société des Bauxites Françaises, Bauxites du Midi, a mining company with deposits near Bédarieux, and slightly over one-third interest in Fonderie de Précision, a die casting foundry headed by Louis Marlio, president of L'Aluminium Français. In 1927 Alcoa helped form another bauxite company, Camares de l'Arboussas. In Italy Alcoa had acquired control of the Societa Anonyma Mineraria Triestina (SAMT), a bauxite-mining company, incorporated in Istria, bauxite-rich province of Italy, and half interest in the Societa Dell 'Alluminio Italiano, which had an aluminum plant at Borgofranco and power stations with 18,000 H.P. Alcoa owned one small Yugoslav mining company, Jadranski Bauxit Dioni'co Drus'tvo, and had two-thirds interest in another somewhat larger one, Primorski Bauxite Company. In Germany Alcoa had set up, jointly with German interests, the Aluminum Die-Casting Corporation of Germany, incorporated in Delaware in 1923, Alcoa owning 47 per cent of the stock. Because German law required real estate to be owned by domestic corporations only, the Aluminium Spritzgusswerke G.m.b.H. was formed as the operating subsidiary of the German-American company, with production in Nürnberg-Arnoldsreuth. In Spain Alcoa acquired in 1925 a one-third interest in Aluminio Español, a plant jointly built by Alcoa, the French and Swiss companies.

In Norway Alcoa acquired in 1923 a half-interest in the Norsk Aluminum Company, an aluminum producing and fabricating company, under circumstances which will be discussed in detail below. Alcoa also bought a one-third interest in Det Norske Nitridaktielskap (DNN), another Norwegian aluminum producer, sharing control with the British and French aluminum companies. In Det Norske Aktielskab for Elektrokemisk Industri, Alcoa bought in 1924 a 55 per cent stock interest. This company owned electrode patents and several valuable water powers, as well as shares in various chemical and electrometallurgical enterprises. The only 100 per cent subsidiary of Alcoa in Norway was Aktieselskapet Kinservik, organized in 1907 to hold a virtually undeveloped water power.

In the Far East, Alcoa, together with prominent Japanese business men, set up in 1921 a sales company, the Asia Aluminum Company (Alcoa owning 60 per cent of the stock), to market Alcoa's fabricated products in Japan. Alcoa also organized Oriental Alcoa, Ltd., in 1926 as a Far Eastern sales subsidiary. South American holdings of Alcoa included a small sales company, Aluminum Company of South America (analogous to Alcoa's European sales subsidiary, L'Aluminium d'Amérique), a public utility and repair yard enterprise in British Guiana, Sprostons, Ltd., and two important bauxite mining companies, Surinaamsche Bauxite Maatschappij (Dutch Guiana), and Demerara Bauxite Company, Ltd. (British Guiana), both organized in 1916.[23]

Truly could Arthur V. Davis tell the Department of Justice in 1921 that Alcoa intended to " enter the international field " in order to " maintain the position which we have won and have always held" as "the principal factor in the world's aluminum situation." [24] (In the 1930's, however, German expansion, abetted by the last aluminum cartel, leaped ahead of Alcoa's growth, and this position of leadership was surrendered.)

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[23] Committee on Listings, Boston Stock Exchange, July 9, 1928, "Aluminium Ltd."

ADVENTURE IN NORWAY

The acquisition of control in the Hoyangfaldene Norsk Aluminum Company was particularly valuable to Alcoa. In one move it eliminated a competitor in the American market, weakened the position of the German industry, acquired a European producing enterprise, and availed itself of a source of cheap power, which was becoming scarcer in the United States.

The Norsk company had excellent cheap power near good seaports, but was deficient in facilities for producing alumina and carbon electrodes. It was a holding company whose subsidiaries carried on the various stages of aluminum reduction and fabrication. Norsk's reduction facilities were located at Hoyanger.

In June, 1920, Charles Kielland, a director of Norsk, came to the United States, one of Norsk's leading markets, to buy alumina either permanently or until Norsk's alumina plant in France was completed. Arthur V. Davis refused to sell alumina to Kielland to be made into aluminum competing with Alcoa's product on the world market. Alcoa instead proposed that Norsk buy alumina from Alcoa and pay for it in aluminum. Alcoa wanted to be exclusive sales agent for all Norsk aluminum in the United States, thus insuring that Norsk's American sales would be at prices determined by Alcoa. Norsk, however, was not willing to market all its American sales through Alcoa.

Alcoa then offered to form a "selling company"—in effect, an operating merger of some of Alcoa's alumina facilities and Norsk reduction facilities. The company, owned 51 per cent by Alcoa and 49 per cent by Norsk, was to market the aluminum so produced. With control in the hands of Alcoa, Norsk would not engage in effective competition with Alcoa on the American market. Norsk was regarding this proposal more warmly than the first, when the German producers, Vereinigte Aluminiumwerke (VAW), Gebrüder Giulini, and Beer, Sondheimer & Company, aided by favorable foreign exchanges, made a bid for Norsk's output, supplying alumina in exchange for aluminum. Preferring that Norsk be linked with Alcoa rather than with the Germans, the American company on July 5, 1921, agreed to buy 50 per cent of Norsk stock with the right to select four of the seven directors.[25]

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[24] Equity No. 85-73, Exhibit 892.

That this purchase favorably affected Alcoa's home monopoly is indicated by the negotiations which Sigurd Kloumann, managing director of Norsk, held with George Haskell, president of Baush Machine Tool Company, William Mayo, and Henry and Edsel Ford, between December, 1920 and May, 1921. The Fords, customers for Baush's duralumin, a strong aluminum alloy, wanted Baush to have an independent (i. e., non-Alcoa) source of aluminum. They had negotiated unsuccessfully for the Muscle Shoals power plant, and finally had suggested that Haskell, financed by them, find and buy a "going concern" producing aluminum. Haskell, who had bought aluminum through Norsk's American agent, now suggested to Kloumann that Norsk sell Baush 9,000 tons of aluminum, a very large order for Norsk, which would have turned it into a custom producer for the Baush-Ford group. In May, 1921, the Fords and Haskell conferred with Kloumann with reference to acquiring Norsk. The incentive is evident: Kloumann told Mayo that aluminum could be produced for *12c* a pound although Ford was then paying *20c* and Alcoa's schedule prices had been as high as *37.5c* in 1917. Abruptly these negotiations were broken off when Alcoa and Norsk made their successful plans for union. Afterwards, Haskell, Laurence J. Harwood, and Hastings (head of Aluminum Products Company), all American aluminum fabricators, were unable to buy Norsk aluminum. They had to deal with Alcoa, or seek out another foreign supplier.[26]

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[25] Brief for the United States, pp. 261-64.

THE EUROPEANS FAIL TO ENCROACH ON ALCOA

But the other European countries offered little dependable relief from Alcoa's price policies. During the 1920's the European producers were frequently unwilling to undercut Alcoa's prices by any substantial amount in their sales to the American consumers of aluminum, if testimony of various government witnesses in the 1937 suit,[27] and documentary evidence are credible. Haskell, for example, who bought aluminum in the years 1919-32 from the British, Swiss, German, and French producers, in no instance was quoted a price below Alcoa's price for virgin aluminum. His experience was corroborated by the inability of several other buyers to obtain a quotation more than a fraction of a cent below Alcoa's current price in the same period. In several instances the foreign producers or their American agents admitted that they were observing Alcoa's prices.

Other evidences point towards some informal agreement between Alcoa and the European producers as to the quantity of aluminum imported into the United States. For example, the Bremer-Waltz rolling mill in 1920 could not buy all the aluminum it requested from the British Aluminium Company and was told of an understanding between Alcoa and BACL as to prices and volume of sales.

On another occasion, Charles Bohn, head of Bohn Aluminum & Brass Corporation, was refused quotations on aluminum by all the foreign producers at the same time that Alcoa was refusing to sell to Bohn. John Henry Main, director of purchases for General Motors, was told by Edward K. Davis, then vice-president of Alcoa, in 1923 that Alcoa had an anti-dumping agreement with the foreigners which confined the latters' sales to old customers only, in order to maintain the ingot prices. Louis Marlio, head of L'Aluminium Français, made a rather similar statement to Haskell in 1924. On at least two occasions, orders of French and British aluminum by American customers were replaced by aluminum deliveries from Alcoa, indicating that the foreign companies had handed the order to Alcoa, just as the Swiss had been in the practice of doing before 1914. In other cases, the British, Swiss, and French refused to sell to Americans, at least directly, although the French and Swiss agents suggested sale through Mexico in order to circumvent restrictions on deliveries to the United States. Agents and company officials occasionally referred to agreements with Alcoa in explaining their refusal to sell, and Arthur V. Davis told Haskell in 1924 of annual cartel meetings regulating sales in the American market.

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[26] *Ibid.*, pp. 264-68.

[27] *Ibid.*, pp. 662-66.

THE GERMAN COMPETITION

The German competition was particularly dangerous to Alcoa. The German aluminum industry had been created during the World War for military purposes by the erection of three plants, using Hungarian bauxite and even domestic clay as raw materials. The German government financed and later took complete control of the largest aluminum works in Europe, the Vereinigte Aluminiumwerke.[28] In 1925, VAW, through its selling agent, Metallgesellschaft (represented in America by the Ore & Chemical Corporation), began exporting large quantities of aluminum to the United States at prices below Alcoa's. Arthur V. Davis sought out Max Von der Porten, head of VAW, proposed to buy a majority interest in VAW, and finally bought a German surplus of 14,800,000 pounds, to prevent its sale to independent consumers in the United States. In 1927 Von der Porten refused to undersell Alcoa in the United States, and indicated that he feared retaliation in Germany if he did. Communications exchanged between Von der

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[28] Government holdings of industrial plants were consolidated in VIAG (Vereinigte Industrieunternehmungen A. G.), a government holding company.

Porten, Metallgesellschaft, and Ore & Chemical Corporation reveal an understanding with Alcoa. Apparently Alcoa complained to VAW in October, 1926, that one of the European producers was quoting aluminum for sale in the United States at 26c delivered (compared with Alcoa's price of 26.9c). The VAW agent denied having done this, and suggested that the British or Swiss agent was responsible. Another communication indicated that the VAW export quota to the United States for 1927 was 3,500 tons, to be sold at ½c below Alcoa prices.[29]

THE CASE FOR EXPLICIT RELATIONS

Although Alcoa denied relations with the foreigners in this period, various factors suggest that relations were maintained. Correspondence in the years 1923-6 contained numerous references to " harmony ", " friendship ", " coöperation ", etc. Alcoa's foreign acquisitions placed the American company in the territories of other producers. Besides, Alcoa, the most powerful company in the world aluminum industry, would undoubtedly be concerned with imports endangering its domestic market control. The Europeans wanted assurances that Alcoa would respect their home monopolies and export markets outside the United States.

Although tacit understandings among oligopolists and " live and let live " codes of ethics have prevailed in various commodity markets, the world aluminum industry had developed no such tradition and was able to control competition only through definite cartel organizations. This was due to the growing market for the new product, which resulted in the expansion of capacity on the part of old firms and in the entry of certain new ones after the basic patents expired. Production expanded erratically as capital outlays taking considerable time (such as power and reduction facilities) were completed. Demand fluctuated with business cycles and with the irregular adoption of aluminum for new uses.[30] Both these influences caused the periodic accumulation of surpluses, which offered strong reasons for price competition. The pressure of large overhead costs undoubtedly encouraged this tendency. It was further reinforced by the desire of each large firm to dump abroad surpluses created by its price control and restricted sales in the more protected home market.

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[29] Brief for the United States, p. 671.

The relatively great value of aluminum in proportion to bulk lowered the barrier to foreign sales ordinarily imposed by transportation charges and even by tariffs. While Alcoa monopolized the *production* of aluminum in North America, it could retain its monopoly of *sales* here only by entering into mutual agreements with other oligopolists in the world industry reserving home markets to each major producer. Alcoa had done this formally through the pre-1914 cartel associations. But Alcoa was under investigation and threat of prosecution by the government all through the 1920's.

The period of informal multilateral agreements among the producers gradually came to a close in the years 1926-31, and was followed by a new period of cartel association. A European cartel was re-established in September, 1926, in Switzerland, to regulate sales of ingot by world quotas, which included both closed (home) and open markets, and by price-fixing. It also promoted the use of aluminum by propaganda activities. According to Oualid, this cartel controlled 46% of the world's industry, with 53 per cent under the control of Alcoa in the United States, Canada, and Norway.[31] It would seem from the evidence of the VAW incident in 1926 that Alcoa may have coöperated with members of this cartel in trying to fix prices and to regulate imports to the United States. However, as Arthur V. Davis testified in the 1937 suit, Alcoa was unwilling to join formally, owing to fear of the anti-trust laws.

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[30] Fluctuations were intensified by the use of aluminum in large, discontinuous capital outlays like the British electrical "grid" system.

[31] William Oualid, *International Raw Materials Cartels. Causes—Effects—Regulation*, Assisted by L. Ballande, League of Nations, Paris, 1938, p. 19.

Expiring in 1928, the cartel was renewed on a more or less similar basis. North American competition, however, resting in part on new capacity, greatly weakened the position of the European producers, while the latter competed unrestrainedly in the sale of semi-fabricated and fabricated goods, the prices of which were not fixed by the cartel. It became clear, particularly after the onset of the depression, that competition could be effectively controlled only by the inclusion of the Alcoa interests and by the regulation of finished products as well as the primary metal.

CHAPTER VI

THE GHOST AT THE ALLIANCE BANQUET

"THE GHOST AT THE BANQUET"

SOON after the 1928 cartel was formed, a new corporation, Aluminium Limited (Alted) was established by Alcoa in Canada on May 31, 1928. The Department of Justice contended that the primary reason for Alted's creation was to enable Alcoa indirectly to enter into international agreements affecting the domestic and foreign commerce of the United States. The reference is chiefly to the international aluminum cartel, the Alliance Aluminium Compagnie, which was set up in 1931, and in which Alted played a leading role. The Alliance, which was the most complete control system in the history of the world aluminum industry, maintained prices, restricted production and inventories, regulated relations with non-member firms, but permitted the German production of aluminum for war to be exempt from quota restrictions.

Alcoa, however, declared that it formed Alted in order to improve the management of Alcoa's foreign business and to take advantage of the British imperial preference in selling to Empire markets. Edward K. Davis, president of Alted, testifying before the Truman Committee on National Defense, used the " foreign-ness " of Alted to defend cartel activities, and so gave some slight comfort to the government's interpretation. He said:

> My companies [sic] being foreign in the United States and permitted, I think, to act in conformity with foreign customs, did . . . assist or participate in the formation of a company in Switzerland of which . . . one of the effects . . . was to keep the output of aluminum by the participants . . . within limits that could be sold during the extreme depression.[1]

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[1] 77th Congress, 1st Session, United States Senate, *Hearings before a Special Committee Investigating the National Defense Program* [Truman Committee], Part 3, May 12, 14, 15, June 16, 17, 1941, Aluminum, p. 931.

Arthur V. Davis cabled to his brother, Edward K. Davis, and Roy Hunt, who were in Europe at the time, and advised them that Edward K. Davis was to be president of the newly formed Alted, and Hunt, president of Alcoa. (This was a convenient method of avoiding controversy over the succession to leadership in Alcoa.)

The new Canadian company received from Alcoa on June 4, 1928, the bulk of Alcoa's foreign properties with the important exceptions of Alcoa Power Company (owner of the Shipshaw power site and first power plant), which was finally transferred to Alted in 1938, and the Surinaamsche Bauxite Maatschappij, holding bauxite lands in Dutch Guiana.[2] Alted was set up as a holding company vested with legal ownership of the subsidiaries which owned Alcoa's world properties outside the United States—bauxite lands in British Guiana, France and Yugoslavia, power sites and developments in Canada, Norway, and France, aluminum reduction works in Canada, Norway, and Italy, fabrication plants in Canada, France, England, and Germany, and selling companies in Europe, the Far East, and South America.

For these transfers of property, Alted paid over its capital stock to Alcoa. Had the transaction ceased there, Alted would have been merely another subsidiary of Alcoa and, if it engaged openly in foreign agreements, would have been vulnerable (like the Northern Aluminum Company) to the Sherman Act. But an extra step was taken—the Alted stock was distributed *pro rata* to Alcoa's stockholders (one share of Alted common for every three shares of Alcoa stock). Then, although the same persons held the stock in both companies, Alcoa could pretend complete severance of formal relations between the two, although actual relation were not severed.

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[2] Compare with formation in the same year by I. G. Farben of the Swiss Internationale Gesellschaft für Chemische Unternehmungen, A. G. (I. G. Chemie) to which I. G. Farben transferred its holdings in America, held after 1929 by American I. G. (now General Aniline & Film Company). Alted claimed to be a distinct Canadian organization independent of Alcoa. American I. G. claimed to be Swiss-owned and independent of I. G. Farben. Joseph Borkin and Charles A. Welsh, *Germany's Master Plan, The Story of Industrial Offensive*, New York, 1943, pp. 115-16.

The close relations between Alcoa and Alted support the idea that Alted was Alcoa's agent in foreign agreements, but Alcoa and Alted denied the inference. Majority stock control in both companies is held by a limited group of key families. Personal ties between Edward K. Davis, president of Alted, and his brother, Arthur V. Davis, were maintained, and other personal relations linked the affairs of the two companies. Financial and business relations were also unusually close, as indicated by the transfer of the Shipshaw power site, the mutual extension of credits, the interchange of production services, and the failure of both firms to compete in each other's markets.

COMMUNITY OF CONTROLLING PERSONNEL

In April, 1933, 51.3 percent of the stockholdings of Alted common were held by brothers Andrew W. and Richard B. Mellon and Arthur V. Davis, who were among the largest holders of Alcoa stock. On January 2, 1939, the two Davis brothers, Roy Hunt and his mother, and the Mellon children and trustees of the Mellon estates held 768,166 shares of the total 1,472,625 outstanding shares of Alted common stock, or 50.9 percent. Holdings of other officers and directors of Alcoa swelled the total to 56 percent of Alcoa stock and 51.56 percent of Alted on January 2, 1939.[3] A relatively small group of key families exercised majority stock control over both corporations, and enjoyed the earnings of both. After nine years had elapsed, on September 20, 1937, holders of 81.53 percent (including the small percentage held by brokers) of Alcoa common stock also held 83.93 percent of Alted common.

EDWARD K. DAVIS

Managerial personnel as well as stockholders gave evidence of intimate relations between the two companies. Edward K, Davis, for many years vice-president of Alcoa, became president of Alted. His stockholdings in Alcoa (14,689 common shares) constitute his largest personal investment. After Alted was formed, he continued to associate closely, in business dealings, with his brother, Arthur V. Davis, Chairman of the Board of Directors of Alcoa, and largest single stockholder in Alted. As stated by Alted itself,

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[3] Equity No. 85-73, Reply Brief of the United States, Filed January 10, 1941, p. 277.

> The personal interests of Mr. Arthur V. Davis in Alted were very great on both financial and—for lack of a better word—sentimental grounds.[4]

Arthur V. Davis advised Edward K. Davis about the formation of the Alliance Aluminium Compagnie (see below pp. 130-2) and together they received in 1931 the foreign producers assembled to consider the new cartel agreement. They also took part with Roy Hunt, president of Alcoa, in a pool handling Alcoa common stock 1929-35.

This personal tie was undoubtedly helpful in coördinating Alcoa and Alted policies. The correspondence offered as evidence in the 1937 suit reveals that the business ability of Edward K. Davis, his understanding of people and market relationships, and the strength of his personality, were second only to those of his brother, leading personality in the world aluminum industry. It would be a mistake to consider Edward K. Davis as a tool of his brother. The brothers may be regarded as co-workers, dividing responsibilities as legal considerations and convenience dictated.

OTHER PERSONAL TIES

Another sign of the continuity of Alted with the old Alcoa organization is that all but one of the Alted officers and directors at the time of the 1937 suit formerly worked for Alcoa.[5]

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[4] Equity No. 85-73, Reply Brief on Behalf of Defendants Aluminium Limited, Edward K. Davis, George O. Morgan, Jr., and Earl Blough, January 10, 1941, p. 42.

[5] Including Leighton McCarthy, Canadian ambassador to the United States, vice-president of Alted, thirty years counsel to the Aluminum Company of Canada and its former vice-president, vice-president also of Saguenay Power Company.

In connection with negotiations preceding the formation of the Alliance, and on other important occasions, Alted was represented by a law firm one of whose members, William Watson Smith, had been Alcoa's counsel for years. Although Alted did its chief banking business through the National City Bank of New York, it maintained banking relations with the Mellon National Bank and the Union Trust Company (also a Mellon bank), and sold large bond issues through them. Roy Hunt, Arthur V. Davis, and members of the Mellon family have long been directors of both banks. E. K. Davis specifically requested that the Swiss bankers chosen as directors of the Alliance (to satisfy Swiss law) be friendly to the Mellon banking interests.

INTIMACY OF BUSINESS RELATIONS

The financial and commercial relations between Alcoa and Alted in the decade after Alted was formed did not show active or threatened competition, or disparity of interests.

After carrying a large idle investment in the undeveloped Shipshaw project on the Saguenay River for ten years after the formation of Alted, Alcoa in 1938 sold the Alcoa Power Company to Alted under extremely favorable terms.[6]

Alted acquired one of the world's greatest water powers, an aid of the first importance in entrenching the Canadian plants as a leading element in the world aluminum industry, with no large immediate financial outlay. Alcoa carried the investment for an indefinite period until Alted expanded its market enough to absorb the power generated at Shipshaw. The sale of Shipshaw took place after the government, in filing its suit in 1937, had charged that Alcoa had acquired this power development in excess of its needs and in order to prevent competition in the aluminum industry. Alted said that the easy terms of the purchase were forced on Alcoa by the absence of any other customer than Alted, i. e., a buyer's market for Alted at the time of sale. However, the transfer had long been contemplated. In 1930 Alted undertook to manage the property "at the request of Alcoa" and "in the joint interest of the present and prospectively future owners." [7]

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[6] Alcoa was to receive $20,000,000 in 4 percent mortgage bonds, and $15,000,000 in installments to be paid when Alted's annual power consumption was greater than 300,000 horsepower. Until that time Alted was to pay a minimum annual payment of $330,000, equivalent to 2.2 percent on the $15,000,000 balance, and $2 for every horsepower year in excess of 165,000 horsepower years used by Alted. At the time of the contract, the installed power capacity was not over 260,000 horsepower. Equity No. 85-73, Brief for the United States, p. 700.

In Alted's early years, Alcoa made large unsecured advances to the junior company, and Alted became financially involved with an Alcoa subsidiary in Italy, which it finally bought on credit in 1931.[8]

INTERCHANGE OF SERVICES

Until a plant making alumina by the Bayer process was set up at Arvida in 1937, Alted relied on Alcoa for years for its supply of alumina (although Alcoa in other cases refused to sell alumina to companies which it regarded as competitors). The Demerara Bauxite Company, Limited, Alted's bauxite mining subsidiary in British Guiana, shipped the bulk of its output, 1928-37, to Alcoa's subsidiary, Aluminum Ore Company, to be made into alumina. In this period Alted received 334,403 long tons of alumina from Alcoa. Until 1934 Alted never had a firm contract with Alcoa for the alumina (i. e., there was no prior agreement as to price), and the price which Alted paid was often below what the Aluminum Ore Company charged Alcoa's plants. Republic Mining and Manufacturing Company, another Alcoa subsidiary, acted as Alted's sales agent for Demerara bauxite sold to old customers (for abrasives, etc.) in the United States after 1928.

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[7] Equity No. 85-73, Exhibit 825.

[8] Alcoa's advances to the Aluminum Company of Canada, 100 percent subsidiary of Alted, made between 1928 and June 30, 1930, ranged from $9,700,000 to $20,300,000, of which at least $3,225,000 consisted of advances on open account without interest or security. Later (in 1930 and 1931) Alted loaned $3,200,000 to an Alcoa subsidiary. The borrower was Prodotti Chimici Nazionali, an Italian concern experimentally producing alumina and potash from leucite, a volcanic earth. Alted bought Alcoa's interest in this firm in July, 1931, and reimbursed Alcoa for all its previous expenses in connection with the leucite process — $1,558,225 — but paid only $58,225 in cash, and the rest in three notes for $500,000 each, the last maturing in 1934. On July 1, 1937, Alted still owed Alcoa $1,200,000 principal, and accrued interest, on these notes—while Alted had six months previously written off its Prodotti investment as a total loss. Alcoa and Alted carried the Prodotti investment for a rather long period of time. Thus they may have threatened Germany's leading potash producers with potential competition. These producers were I. G. Farben, Wintershall, and the German government holding company Vereinigte Industrieunternehmungen A. G. (Viag). Magnesium is a by-product of the making of potash from German carnallite deposits. At this time Alcoa was dividing the field of magnesium production with I. G. through the Magnesium Development Corporation (see Chapter VIII). Also, I. G.'s Bitterfeld aluminum plant and Viag subsidiary VAW were included in the Alliance Aluminium Compagnie along with Alted, and in 1934 secured increased quotas under pledges of withholding the added production from the world export market.

As Alted lacked sufficient fabricating facilities, it relied on Alcoa to fabricate aluminum products, such as sheet, on a toll basis. Alcoa then shipped the fabricated articles directly to Alted's customers. Alted received this service below the actual cost (including overhead) to Alcoa.

The intimate dependence of Alted on Alcoa for alumina and fabrication services was in part reciprocated by Alcoa's reliance on Alted's production of virgin aluminum supplied at " demonstrably low prices " by the Canadian company.[9] By these interchanges, a continental integration of the production flow between the two corporations was partially maintained. It gradually declined as Alted developed its Canadian properties into an integrated system, and, as an operating unit, became independent of the parent company.

FAILURE TO COMPETE

Not until 1937 did Alted sell any aluminum in the United States.[10] And Alcoa until 1937 did not export aluminum or its products into Canada or other foreign markets.[11] The rare exceptions, in virgin aluminum, were two sales in 1932 and 1933 which were insignificant in comparison with Alcoa's domestic sales in the same period. Sales of fabricated products abroad amounted to .054 percent of Alcoa's total sales 1929-37. In 1937, when the armaments boom led to the dissolution of cartel restrictions, Alcoa resumed export trade.

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[9] To quote one typical contract, the 1937-8 contract stipulated a delivered price (including freight and duty of 4½c.) of 17¼c., as compared with the United States market price of 20.08c. Brief for the United States, p. 712.

[10] One of its three sales in 1937 was over 2 million pounds to the Aluminum Goods Manufacturing Company in which Alcoa and its officers

Companies in which Alcoa and Alted were interested did not cross into each other's market in cooking utensils. The Aluminum Goods Manufacturing Company (in which Alcoa has a large minority interest) did not sell in Canada, and Aluminum Goods, Limited, owned jointly by the Alted subsidiary, the Aluminum Company of Canada (51 per cent), and the Aluminum Goods Manufacturing Company (49 per cent), did not sell in the United States.[12]

Alcoa could profitably have ventured into Alted's territory. Alcoa had large stocks of unsold virgin aluminum in storage in the United States and Canada between 1928 and 1937, reaching a peak of 298,000,000 pounds in 1932.

Alcoa's failure to sell in world markets after 1931 may have been a *quid pro quo* associated with the establishment of world quotas (outside the United States) through the Alliance agreement involving Alted and the European producers. Alted, too, tended to avoid the home markets of French, German, and

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have a large minority interest. The other two were relatively small sales, compared with Alcoa's production—150,000 pounds to Bohn and 80,000 pounds to the Hoover Vacuum Cleaner Company.

[11] "We make no contention that Alted and Alcoa have competed with each other except to a very limited extent [but] they were at all times free to do so." Reply Brief on Behalf of Aluminium Limited, et al., p. 7.

[12] Aluminum Goods, Limited, was incorporated on December 24, 1930. Its stock of $500,000 was turned over to the Aluminum Company of Canada in return for the latter's facilities for the manufacturing of cooking utensils. Six months later, Aluminum Company of Canada sold 49 percent of the stock to the Aluminum Goods Manufacturing Company. This stock was sold back on June 6, 1938, during the trial of the U. S. v. Alcoa suit in which the original transaction was included in the charges. Equity No. 85-73, Petition filed by the United States, April 23, 1937, Par. 89.

Swiss producers, partly as a result of tariffs and import licensing; but Alted associated with these producers, and with the British Aluminium Company, in the Alliance and in a number of special price and quota agreements.

WHY ALTED AVOIDED THE UNITED STATES

Alted failed to tap the American market although it was operating far below capacity in the depression.[13] Heavy tolls for unused power, and a large fixed plant, contributed incentives to find new markets. Edward K. Davis repeatedly attempted to utilize Alted's idle facilities, in producing alumina for Norsk, British Aluminium Company, and the Soviet Union.

As Alted's total delivered cost to the United States, including freight and tariff, lay well below the American market price, Alted could have reduced its idle capacity by sales in this market. The reduction of the American tariff on British Empire aluminum from 5c. to 4c. in June, 1930, and then to 3c. on January 1, 1939, and the fall in unit costs at Arvida owing to expansion of output, widened the realizable profit margin.

Alted contended that it avoided the American market because of fear that a wave of imports would have led to tariff increases. Such a long run point of view was not adopted by European producers, who exported to the United States whenever there was a chance of short run profits, unless curbed by cartel restrictions.

ALTED IN THE WORLD MARKET

Alted also argued that it preferred to concentrate sales within the British Empire and other places lacking a domestic producer. The United States, and later Britain and Japan were its leading outlets. The United States took through Alcoa 38.3 percent of Alted's sales in 1928, 60.8 percent in 1929, and 47.8

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[13] Both Norwegian companies in which Alted had shares were operating ⅓ to ⅔ below capacity at different times between 1933 and 1937, and in the trough of the depression Alted's Canadian subsidiaries were operating at 50 percent or less of capacity. The Shawinigan plant was completely shut down.

percent in 1930; Great Britain took between 24.4 and 41.2 percent of Alted's sales 1932-7; and Japan took 26.3 to 45.3 percent of Alted's ingot 1931-7. All Alted's American sales were made to Alcoa, ordinarily below the current market price realized by Alcoa on resale in virgin or fabricated form. There is disputed evidence that Alted refused to quote prices in 1931 to Baush Machine Tool Company, an American consumer. Japan was one of Alted's largest customers even after 1939, although freight charges to Japan were more than double those to the United States, and the Japanese tariff was increased in June, 1936.

The unusual financial relations of Alted and Alcoa, their interchange of supplies resulting in a continentally integrated production, their avoidance of each other's market, and the personal ties of identical controlling stockholders, brother officers, etc., should leave little doubt that when Alted entered into the Alliance in 1931, the interests of Alcoa were not entirely neglected.

FOREIGN RELATIONS CONTINUE

The period of two and a half years between the formation of Alted and the first negotiations leading towards the Alliance Agreement do not constitute an unexplained gap in the cartel relations between the Alcoa-Alted interests and the European producers. In 1928 E. K. Davis entered into an agreement with Louis Marlio, head of L'Aluminium Français, dividing the Russian market in aluminum, and calling for the quotation of uniform prices on Russian orders.[14] Alted also divided the Indian market for fabricated goods with the British Aluminium Company (BACL). By the Zurich Agreement of July 18, 1930, Alted got 52 percent of the Japanese market and the Europeans,

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[14] Marlio was to exclude the other Europeans from the Russian business. The agreement did not establish complete harmony between the two companies, as Alted wanted a larger share of the trade, and finally secured the bulk of it. Equity No. 85-73, Exhibit 818.

48 percent. Alted was to be exclusive sales agent for all, was empowered to fix prices and terms of sale, and received commissions ranging from 2-5 percent on sales made for the Europeans.[15] In November, 1930, the head of BACL indicated to George Haskell that the British had made a comfortable agreement with Arthur V. Davis, and refused to sell below Alcoa's price in the United States. Hints of similar arrangements involving the Swiss company AIAG were dropped by its agents to two American fabricators about the same time. Alted said that it tried " to maintain cordial relations with the individual members [of the old cartel] and on several occasions was partially guided in its actions by the desire to coöperate with such members," also that Alted followed the cartel price in ingot sales to Europe in certain instances for self-protection in markets where its competitors were protected and where they acted in concert.[16]

It seems likely that Alted was very active in bringing about the formation of the Alliance, although it denied having taken the initiative.[17] For the original draft of the new cartel agreement was written by E. K. Davis in the winter of 1930-1. Just prior to this Arthur V. Davis had visited Europe, where he saw his fellow producers of aluminum. These facts suggest that the initiative lay, at least in part, on the western side of the Atlantic. The most active years of the Alliance found E. K. Davis functioning as cartel " whip ", bringing recalcitrant members and outsiders into line with the Alliance policies. Throughout the formative period, he kept his brother informed as to the principal details of the plan, and after the incorporation of the Alliance, continued to keep Arthur V. Davis abreast of Alliance affairs.

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[15] The agreement bound the Europeans to cancel all agent's contracts previously in force with Japanese firms. A prior agreement between Alted and BACL concerning sale of electrical conductors in Japan was embodied in the Zurich Agreement, except that all the Europeans could participate in the supply formerly pre-empted by BACL. The common sales agency is most often found "in industries producing highly standardized and bulk commodities." Depriving members of "direct contact with the open market" enables "the strictest form of market control." This form "quite openly" announces "elimination of free competition among the cartel members." Equity No. 85-73, Exhibit 814. Karl Pribram, *Cartel Problems: An Analysis of Collective Monopolies in Europe with American Application*, The Brookings Institution, Washington, 1935, pp. 47-8.

[16] Equity No. 85-73, Exhibit 822 would indicate that Alted in 1929 had commitments to observe the standard price in England.

[17] Equity No. 85-73, Brief on Behalf of Defendants Aluminium Limited, et al., December 2, 1940, pp. 52-55.

In April, 1931, at the invitation of E. K. Davis, Marlio and Bouchayer of L'Aluminium Français, Cooper and Morrison of BACL, and André-Couannier of Alted's Paris office came to the United States to discuss the formation of the new cartel. The Swiss and German companies were represented at the conference by the British and French executives. The time of the trip had been so arranged that Arthur V. Davis would be able to receive the visitors. The aluminum company officials held their conference at Montreal, led by E. K. Davis, who presented his plan to incorporate the "Aluminum International Corporation " in Holland, somewhat along the lines of the international copper cartel. The conferees discussed proposals that, to control prices, the cartel control members' production through quotas, and buy and sell aluminum, trading with members only; and that the cartel use its metal purchases as collateral for bank credit to finance further purchases.

After the Montreal conference, the party went to inspect Alcoa's aluminum reduction plant at Massena, New York, where they were met and guided by Arthur V. Davis and Roy Hunt. Then they proceeded to Alted's Arvida plant.[18]

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[18] The purpose of the tour, the government argued, was to impress the foreigners with Alcoa-Alted's potential threat to the European market if they failed to come to terms respecting Alcoa's home monopoly, and to improve Alted's bargaining position in demanding a large quota. Arthur V. Davis at Massena showed the visitors " the newly created structural mill, which was unique in the aluminum industry " in hope of foreign orders. Alted wished to " demonstrate the scope " of its Canadian properties on the Arvida tour. Brief on Behalf of Aluminium, Limited, et al., p. 61.

FINAL TERMS

The final terms of the agreement were decided on at meetings in London and Paris in the late spring and summer of 1931, attended by E. K. Davis. The Alliance Foundation Agreement was signed in Paris on July 3, 1931; according to its terms the Alliance Aluminium Compagnie was incorporated for 99 years in October, 1931. Two former officials of the old cartel, Marlio and Cooper, were nominated by Edward K. Davis as chairman and vice-chairman of the Alliance. Ludwig Braasch, Alcoa's Berlin manager until 1920 and thereafter a director of Alted, became manager of the Alliance, and George Hodson, former salesman for Alcoa and Alted, became assistant manager. Edward K. Davis refused office as vice-chairman.[19]

THE NEW MECHANISM

The purpose of the Alliance was to improve the control mechanism of the old cartel, by putting the organization on a tighter, more permanent, legal basis, and by introducing new control devices which would effectively regulate production, sales, and prices.[20]

The Alliance mechanism permitted the continuance or organization of agreements among the members relating to particular markets.[21] The important agreements involving Alted, besides the Zurich Agreement of 1930 which was continued under the Alliance, were as follows:

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[19] His stated reason for refusing was the current involvement of Alcoa in the Baush suit, in which monopolistic activities and cartel-fixed prices were charged. *Ibid.*, p. 13.

[20] The question came up of joining the International Propaganda Bureau in Paris, child of the 1926 cartel, to the Alliance. E. K. Davis favored uniting the two organizations, but leaving the Propaganda Bureau in Paris and encouraging each group within the Alliance to conduct its own "line" of publicity. "After all, the public likes to feel that amongst the firms from which it buys its materials there is at least a certain amount of individuality, even if there is no destructive competition. The public resents the appearance of a monopoly." Equity No. 85-73, Exhibit 826.

[21] Equity No. 85-73, Exhibit 784.

1. The division of British Empire orders for electrical conductors with BACL.

2. The pooling of alumina and aluminum orders to be shipped to the U. S. S. R. Prices were fixed and non-competitive bidding was agreed on. The agreement was dated March 15, 1935.[22]

3. An agreement with BACL and Neuhausen in regard to United Kingdom ingot prices, February 16, 1937.

4. A 1937 agreement on prices of fabricated aluminum in Central Europe.[23]

The Foundation Agreement permitted the Alliance to buy and sell aluminum or warrants representing aluminum at a price fixed by the Alliance. No member would have any reason to sell on the open market below the price it could get from the Alliance, so the Alliance buying price *established a minimum market price.*[24] The Alliance buying price affected fabricated goods as well as ingot, since it would not pay a producer to sell fabricated goods on the open market for a price below the Alliance (ingot) buying price plus cost of fabrication. Although comprehensive, the mechanism of control was extremely simple.[25]

FIXING QUOTAS

To prevent too great a cash drain through buying of members' surpluses, the Alliance was empowered to restrict the production of its members by periodically fixing quotas based on the number of shares of Alliance stock held by each. Fourteen hundred registered shares totalling 35,000,000 Swiss francs had been issued, of which Alted was allotted 400 (or 28.6 per cent), as well as a pledge that, if the production per share exceeded 100 tons a year, Alted was to be entitled to 50 per cent of the added quotas. The Alliance could reduce the quotas if the open market were unable to absorb the current production at the market price (as determined by Alliance prices), and members were selling large surpluses to the Alliance. The Alliance could also, of course, lower its buying price, but the original view of the founders was undoubtedly that the Alliance keep up its buying price and restrict production in order to maintain a high open market price.[26]

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[22] Equity No. 85-73, Exhibit 808.

[23] Brief on Behalf of Aluminium, Limited, et al., p. 50.

[24] The Alliance selling price was expected to ensure the sale of stocks held by the Alliance before the members would raise their market prices above the Alliance price—to protect Alliance finances in a period of rising demand, when members were producing at full capacity. Otherwise, according to E. K. Davis, the selling price should differ from the buying price only by the cost of transportation, as the only reason for purchase by a member from the Alliance would be to save the cost of transporting aluminum. Equity No. 85-73, Exhibit 872.

[25] Equity No. 85-73, Exhibit 784.

. The shareholders agreed to sell to the Alliance on its incorporation, at £55 a ton, all stocks exceeding 40 tons a share, except for permanent working stocks in fabricating plants, so that all retained uniform tonnages per share. Until December 31, 1931, the members were to observe the old cartel price of £85 a ton, but thereafter the Alliance stood ready to buy all stocks of members above 40 tons a share at £70 a ton. At the end of 1931, the Alliance bought 20,000 tons of aluminum from shareholders, and by May, 1932, had a stock of 43,500 tons. The funds for these purchases came from shareholders' subscriptions (25 percent of stock required in cash) and from bank credits. The Alliance owned its shareholders 30,000,000 Swiss francs for the remainder.

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[26] Equity No. 85-73, Exhibit 874, Minutes of the Sixth Meeting of the Board of Governors, March 4, 5, 1932: "It [is] of the utmost importance to maintain an A. A. C. buying price... the A. A. C. being obliged to provide for a substantial decrease of its stockholdings rather than to finance new purchases of metal, a further curtailment of production is becoming unavoidable." The Alliance at this time had only 10,000,000 Swiss francs credit at the Swiss banks and $1,000,000 (United States currency) at the Bankers' Trust Company, London.

EFFECT ON PRICES

How did the Alliance buying price influence the sales prices of member firms, and particularly of Alted? According to a letter from MacDowell to E. K. Davis, January 18, 1932, Alted followed the policy of quoting to casual inquirers (e. g., trade journals) a nominal price of £80 (gold), but to "serious" buyers, a price of £70 c. i. f. Antwerp, the equivalent of the new Alliance buying price. This policy was followed by Alted sales subsidiaries covering the Far East, Britain, continental Europe, and South and Central America. Within Canada, the equivalent of the £80 price was maintained. The price to "the largest buyers in the United States" was permitted to be "as low as 15c. f. o. b. Arvida," equivalent to £70 gold, but to other American buyers the £80 (gold) price was retained. At this time Alcoa's net received price (after freight) was 22.9 cents. As it was only in the United States that Alted discriminated between "the largest" and other buyers, this price schedule confirms the preferential relation between Alted and Alcoa, and by a higher price (2.2c. a pound more) to outsiders indicated Alted's intention not to solicit sales in the United States. The closed Canadian market was to be charged more than Alted was quoting either to Alcoa or to the open markets of the world.

When the Alliance raised its ingot price to £71 (gold) in January, 1933, MacDowell instructed the Alted agent in Geneva to follow the increase. He pointed out that as Alted competitors would have no cause to offer ingot at a price "returning less than could be obtained by selling it to the Alliance," Alted could meet competition at £71 except where the competitors had tariff protection.[27]

DISCIPLINING THE BRITISH

The chief problem faced by E. K. Davis as cartel leader of the high-price, restricted-output policy, was the disciplining of the BACL. When England left the gold standard in September, 1931, he repeatedly requested that BACL keep its domestic ingot prices in conformity with the Alliance buying price, in order to help stabilize prices elsewhere, and insisted that the British tariff would ward off " inconvenient encroachment from third parties." [28] He even offered to buy enough alumina from the British company in 1933 to absorb its idle capacity.

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[27] Equity No. 85-73, Exhibit 802.

The fall in the pound and the rise in the Alliance buying price from £70 to £71 combined to negate the efforts of BACL to raise its prices toward the Alliance minimum. E. K. Davis feared that the British low price policy was a device to enlarge sales, and thereby to show that the British " should have had, or should in the future receive, a larger number of Alliance shares." Cooper denied this aim and repeated his persistent protest that the Alliance buying price was too high.[29] Not only did the BACL agitate for lower prices, but it requested increased quotas in 1932.

To meet the low British price, MacDowell of Alted, which was sales agent for several companies, wished to reduce the price quoted in Japan, but was asked by AIAG: " Would you not fear re-export of Japanese aluminum to United States? " Alted's lowered price in Japan

> permits the re-entry into the United States market in spite of the duty of 4c. per lb., at prices which are well below the established official price of the Alcoa. In our opinion, some action should, therefore, be taken in order to avoid any price disturbance in the United States market.

MacDowell replied (January 20, 1932):

> We do not fear re-export of Japanese aluminum because the price is always under our control and all sales are made on

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[28] He was wrong. The success of subsidized German dumping in 1933-4 at 70 percent of the German price after freight and incidental charges showed that the British 10 percent duty was inadequate to keep out aggressive competition from "third parties."

[29] Equity No. 85-73, Exhibits 791, 795.

> duty paid basis which prevents buyers from re-exporting material in ingot form without sacrificing amount paid for duty . . . believe chances are remote that Japanese exports of fabricated products will disturb other markets.[30]

This instance appears to show that Alted price policies were planned to " avoid any price disturbance in the United States market."

CONTROL OF PRODUCTION

The first quotas set by the Alliance went into effect on July 1, 1931, at 80 tons a share—according to which Alted, including ⅓ of D.N.N. and ½ of Norsk production, got 32,000 tons a year, as compared with its previous production rate of 40,000 tons a year. In 1932 quotas were cut to 53 tons a share, and, at the suggestion of E. K. Davis, supported by the French, to 50 tons in 1933. In 1934, a recovery year, quotas went up to 55 tons, and in 1935 to 53 tons plus certain specially authorized additional production. The penalty for over-production was confiscation of the excess by the Alliance without compensation.[31] After the German members successfully pressed for relaxation of the quota restriction beginning in 1934, other members, wishing to share in the world demand, finally secured the abolition of the Foundation Agreement. At the suggestion of E. K. Davis, the forfeiture of excess production was abandoned in 1936 and replaced by graduated royalties for excess production. Such royalties were paid by Alted between 1936 and 1938 on excess production including shipments to Alcoa in the United States.

Clause 10 of the Foundation Agreement permitted Alted to produce aluminum for Alcoa on a toll basis, from Alcoa's raw material, outside of quota restrictions. This must have implied some tacit limitation on Alcoa, for the unlimited export of Alted-made aluminum by Alcoa would have disturbed the Alliance mechanism for control of the world market.

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[30] Equity No. 85-73, Exhibit 812.

[31] Owing to the difficulty of an exact regulation of production, a 5 percent margin for error was permitted over the fixed maximum production in any calendar year, to be adjusted within the following year.

According to E. K. Davis' interpretation, the Foundation Agreement expressly included exports to the United States within the quotas of Alliance members. But the foreigners wished to interpret the Foundation Agreement so as to exclude the United States market from their quota restrictions, and thus to open it to imports from Europe. Alted's contrary view prevailed in 1936, when the quotas were made expressly applicable to the United States, in return for Alted's giving up its special privilege of producing aluminum for Alcoa on a toll basis outside its production quota.

In 1936 all aluminum produced regardless of destination was subjected to royalties if in excess of the " free " quota of 70 tons a share. Royalties were reduced for the period January 1, 1937-March 31, 1938, and the free production was raised in 1937 to 100 tons and in the first quarter of 1938 tq the annual rate of 115 tons. Finally, after March 31, 1938, no royalties were payable regardless of production. The gradual lifting of quota restrictions and royalties reflects the armaments boom that assured large and profitable aluminum markets.

ATTITUDE TOWARDS OUTSIDERS

Alcoa was never regarded by the Alliance as a true outsider. From the start the Alliance had contemplated the inclusion of outside firms and strict disciplining of relations between members and outsiders. The Montreal Draft of the Foundation Agreement, written by E. K. Davis, had authorized 3,000 A shares (voting shares), of which 1680 were tentatively distributed among the members.[32] Of the remaining 1,320 shares, 900 were to be allotted to Alted and 300 to the principal European producers when production quotas exceeded 100 tons a share. Sixty were to be used by Alted to bring into the Alliance

[32] One thousand to the French, German, Swiss, British, and Spanish companies, 500 to Aluminum Company of Canada, 120 to D. N. N. and 60 to Norsk.

the three Italian companies.[33] Sixty were to be allotted by the Alliance Board of Governors to some other group to bring in other outsiders.[34] The outsiders were small but their inclusion was desired by E. K. Davis in order to stop leaks in the Alliance control system.

Other stipulations in the Montreal Draft disclose a hostility to outside producers. The cartel was not to trade with outsiders, and no member could acquire a part interest in outside companies, although acquisition of 100 percent interest was permitted. The by-laws of the Alliance required consent of 75 percent of the A shares to any transfer of shares to an outsider.[35] The rules as to outsiders were reiterated at the Board of Governors meeting on February 14, 1936, after the cancellation of the Foundation Agreement. Consent of 90 percent of the shares was required for purchase by a member of part interest in an outside firm, or to sale of alumina or alumina plants to outsiders.[36]

At the October, 1931, meeting of the Governors, E. K. Davis undertook to negotiate with the Italians and Norsk to bring them into the cartel,[37] Marlio to negotiate with Aluminio Español, and Bloch, representing Neuhausen, with Mermod and the Giulini plants. Thus the heat was put on the small outsiders. The same meeting laid down the law concerning trade between Alliance members and outside firms.[38]

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[33] Societa Anonimo Veneto Alluminio (SAVA — a wholly-owned subsidiary of AIAG), Societa dell'Alluminio Italiano (SDAI—Borgofranco owned by Alted), and Societa Italiano dell' Alluminio (SIDA—Montecatini —Italian-owned).

[34] The Aluminium Corporation (Wales), Elektrizitätswerke Stern & Hafferl, A. G., International Aluminium Company, Limited (which owned a plant in Norway through its subsidiary Haugvik Smelteverk), and S.A. pour l'Industrie des Métaux (Mermod). Davis was able to write on May 13, 1932, that "Alliance Aluminium Cie owns a majority of the capital shares of Aluminium Corp. and International Aluminium Co."

[35] Equity No. 85-73, Exhibit 786.

[36] Certain exceptions were specifically listed. Equity No. 85-73, Exhibit 789.

[37] That is, with the Norwegian-owned half of the Norsk company. Determination of the Fascist Italian government to build up an autonomous aluminum industry prevented inclusion of the Italian firms. Reply Brief on Behalf of Aluminium, Limited, et al., p. 28.

On the proposal of Alted, the Alliance in 1934 prevented Giulini Brothers from enlarging their plants or dealing with outsiders, in return for a contract to buy regular quantities of the Giulinis' alumina annually and to take over their unsold tonnage. At the May, 1934, meeting, the shareholders agreed to withhold technical assistance to any enterprise for the production of aluminum or alumina in Japan and the Japanese-controlled areas, and in Czechoslovakia, Yugoslavia, Greece, Hungary, and British India. Alcoa had previously informed Edward Davis that in the event of a request for assistance (from Japan, the immediate inquirer) Alcoa would refuse; Alted subsequently told the Alliance that Alted and Alcoa would not grant aid to Japan. (Japan was one of Alted's chief markets up to World War II. (See p. 129.)

WAS ALCOA AN OUTSIDER?

The Italian companies, Guilini, International Aluminium Company, and Aluminium Corporation were all discussed, approached, and if possible, conquered. Only Alcoa was absent from this list of potentially dangerous outsiders.

Writing in May, 1932, E. K. Davis noted that

> There are . . . outside the Alliance . . . only one important producer, viz. the Aluminum Co. of America . . . and [three] relatively unimportant European producers . . .

The Alliance included 89.46 percent of the world production excluding the United States—if the production of the U. S. S. R. and Japan, which did not enter the export market, be discounted as negligible. It is questionable that the cartel could succeed without some sort of understanding with the leading aluminum producer of the world. That it was a success was unequivocally stated by Edward K. Davis in May, 1932:

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[38] The Italian firms with which Neuhausen, VAW, Bitterfeld, and Alted were permitted to conduct limited trade were mentioned by name. But Alcoa was not. However, Alted was permitted to buy aluminum articles which it needed to complete products of its own fabrication. The German and Swiss companies had demanded the right to continue purchases from the Italians under pre-Alliance contracts; in return, Alted and the French were allowed to trade with Borgofranco and Aluminio Español respectively.

> The performance of the Alliance . . . has been highly successful. In spite of the untoward business conditions everywhere prevailing, the "Alliance" has largely accomplished its purposes. The overproduction in Europe and Canada has ceased. The average price of metal has gradually risen to the figure at which the Alliance A.C. buys aluminum from its shareholders[39].

Later, in 1939, Paris commentators noted that

> The Alliance . . . has fully justified the hopes of its founders, since the 1937 world consumption (501,700 tons) slightly exceeded the production (491,000 tons)—all the more remarkable considering that the Alliance controls effectively only about 60% of the world production.[40]

It is probable that, because of Alted's membership Alcoa's activities were not considered dangerous by the Alliance.[41] The implication would be that Alcoa's domestic monopoly was respected, in return for assurance that Alcoa's foreign sales would pass solely through quota-controlled Alted, and that

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[39] Equity No. 85-73, Exhibit 806.

[40] Banque Nationale Française du Commerce Extérieur, Memorandum, July, 1939.

[41] "The view often expressed in German publications is that this European cartel was under strong influence of American groups [which] . . . influenced the prices of the European cartel to avoid danger to the American price level. . . . I have seen the statement repeated again and again in German publications, which refer always to the fact that a former Vice-President of an American trust was in charge of the management of the European cartel." 77th Congress, United States Senate, *Hearings before the Committee on Patents on S. 2303, A bill to provide for the use of patents in the interest of national defense or the prosecution of the war, and for other purposes.* Part 3, April 27-May 2, 1942, p. 1311. (Testimony of Heinrich Kronstein.)

Alcoa would not aid outsiders to set up competing plants contrary to the wishes of the Alliance.[42]

When the Alliance bought its members' surplus stocks, those stocks were taken off the market and prevented from depressing aluminum prices.[43] Therefore Alted's annual report for 1932 stated:

> World stocks of aluminum are not excessively large. They are in firm hands and do not weigh unduly upon the market.

Alcoa's surplus stocks in 1932 were at a peak—258,000,000 pounds in the United States and 40,000,000 pounds in Canada. Yet Alcoa did not attempt to export to reduce the surplus. Meanwhile, the Alliance purchases, minimum support price, and restriction of production made it unnecessary for the Europeans to dump large stocks in Alcoa's domestic market.[44] In 1929 6.6% of European output was exported to the United States, but in 1932, when the cartel was fully in operation, only 2.8% of European production was sent to the United States (the absolute drop was from 19,900,000 to 5,300,000 lb.) This should be contrasted with the experience of the 1921-22 depression, in which European exports to the United States greatly increased, as a way of unloading surplus stocks.

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[42] "From the standpoint of Aluminium Limited and the other foreign producers, there was obviously no point in their refusing to make a sale [of technique to Japan] if the prospective purchaser could turn around and buy from Alcoa." Brief on Behalf of Aluminium Limited, p. 76.

[43] According to Oualid, *op. cit.*, p. 20, aluminum prices were very stable in aluminum-producing countries after 1931, with a slight tendency to decline. Although production increased 39 percent in 1935-6, the price did not change—a tribute not only to the effectiveness of the Alliance but to the revival of world demand. In the non-producing countries, the Alliance did not officially prevent price competition (although allowing regional cartels to be set up among its members). Therefore aluminum-importing regions (Central Europe, Belgium, Holland, South America) got aluminum in 1935-6 at prices of £80-85 a ton, while the London price was held stable 1932-6 at £100 a ton. This contrast may merely point up the old cartel distinction between open and closed markets.

Marlio claimed that the Alliance progressively and continuously reduced prices while avoiding wide fluctuations which would disturb the market, in contrast to the high-price policy of the copper cartel. This policy of the Alliance, he said, was designed to encourage wide consumption of aluminum by stabilizing expectations as to price. Only in short crisis periods, said Marlio, did the Alliance fix prices. As an evidence of the protection of consumer interests by the Alliance, he cited the absence of complaints by consumers to their governments about exorbitant aluminum prices—and the fact that no new firms entered the industry. The latter could also result from enforcement of Alliance policy forbidding aid to outsiders, and from domestic monopolies of Alliance members.

As the Alliance price was higher than Alcoa's price after 1932, there was presumably no reason for foreigners to increase sales in the United States at prices lower than those which the Alliance would pay. The gap between the prices was the margin of protection which the cartel afforded to Alcoa. While imports did increase after 1933, they were a smaller share both of European output and of the American supply than in pre-Alliance days.[45]

At the same time, as the Alliance reduced production quotas to keep market prices up, and to avoid being loaded with large surpluses, the cartel needed some assurance that the powerful American producer would not expand its foreign sales in the face of European restrictions. Such a possibility would have wrecked the Alliance. The assurance of Alcoa's cooperation may have been supplied by Alted.

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[44] Aluminum prices were protected by the fact that the international copper cartel kept prices high before 1931. But the collapse of the copper cartel brought the price down to £28, less than one-third the price of aluminum. The aluminum cartel prices were threatened until the re-formation of the copper cartel and the rearmament demand caused copper prices to soar again. Meanwhile the cartellized tin producers, through an output restriction scheme launched in 1931, succeeded in raising tin prices from £100 to £230 a ton. The success of Alliance prices depended in part on the simultaneous control by other metal cartels. Otherwise, aluminum prices would have fallen markedly. (Alfred Plummer, *New British Industries in the Twentieth Century,* London, 1937, p. 204.) When copper and tin prices fell at the end of 1937 to 46 and 40 percent respectively below their peaks for 1937, Alted contemplated a 9 percent cut in aluminum prices in England.

[45] 1931-37 imports were only 4.7% of European production compared with 14.4% 1920-27; and 1931-38 imports were only 8.1% of the American virgin supply, compared with 11.78% 1920-29. Appellate Brief for the United States, pp. 308-09; Appellate Reply Brief for the United States, pp. 127-29.

THE GERMAN QUESTION

The Alliance policy of restriction was stretched to accommodate the German rearmament program in 1934. At the meeting of the Alliance Board of Governors on May 24, 1934, the Germans received a special dispensation, owing to what the Alliance called " *force majeure* " in the German situation. They were permitted a supplementary production of 13,000 tons " in order to meet domestic requirements " and were to take over a supplementary quantity of Giulini alumina in addition to buying 100 tons of aluminum from the Alliance for every 233 tons produced above their quota. The Alliance agreed to grant an open book credit to the VAW, for principal and interest on the value of the aluminum sold to the VAW, until the Reichsbank permitted the necessary foreign exchange transaction paying for the deliveries to take place. Should the Germans increase their exports of aluminum over the 1933 level, they were to buy from the Alliance an amount equal to the excess, The VAW and Bitterfeld, in return for these considerations, speaking through their cartel representative Schirner, pledged their support of the Alliance structure " for years to come." The minutes of the meeting forcibly reveal a major concession on the part of the other cartel members in an effort to prevent the German members from seceding from the Alliance in order to meet the requirements of the Nazi war machine.[46]

The Germans told the Alliance that the quota increase was necessary in order to replace imported copper under the Nazi program of *Autarkie*. Marlio said that the Alliance, not sure of the Germans' intentions, asked them to show how aluminum had replaced copper, but the results of the study (made in 1935) were not demonstrative.

The Alliance permitted the increase in the German quota on condition that its members were protected against the use of the new production in the export market. It had learned something from experience of the German dumping in the British aluminum market, 1932-4. Edward Davis was opposed to the concessions, and unsuccessfully proposed that 3,000 tons of Alcoa aluminum stored in Canada be used to fill the German requirements.[47] As a result of the 1936 revision of the Alliance, the German production was exempted from royalties, and the other members agreed to give 1,000 tons of aluminum free to the Germans.

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[46] Use of aluminum for consumer goods in Germany was restricted about this time, so that the new production was used for military purposes, chiefly airplanes.

The German aluminum output rose rapidly when freed from Alliance restraints. It was 18,900 tons in 1933, rose to 37,200 tons in 1934 and to 175,000 tons in 1938. American production was 38,614 tons in 1934 but did not keep pace with the German expansion, being only 33,647 tons in 1935 and 130,129 tons in 1938. The percent of world output claimed by the United States dropped from 27.27 percent in 1933 to 22.95 per cent in 1938, and Germany's share rose from 13.35 percent in 1933 to 30.87 percent in 1938.[48]

THE ALLIANCE HIBERNATES

After 1936 the restrictions were gradually lifted, as the need for a support price and for the control of inventories was obviated by the recovery of world markets through armaments production. The cartel was suspended on March 31, 1938 by the resignation from the Board of Governors of the French, English, and Canadian members, who obtained also the resignations of the Germans. Only Swiss personnel remained. The chairman of the board of directors is the former president of the Swiss Confederation and the other members of this board are Swiss bankers. The Alliance became a sleeping corporation—as Edward K. Davis said, it is in "suspended animation." [49] The Swiss directors are conserving the assets of the corporation against the hour of its revival. Market control by the Alliance became unnecessary and impossible while the war established government controls over aluminum markets in all belligerent nations, put Alliance members in opposite camps, and changed the state of aluminum supply from surplus to shortage. But the corporate stockholders retain their stock holdings. The Alliance was incorporated for 99 years, but its future revival is less likely since Alted has been enjoined from making certain agreements. (See below.)

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[47] Equity No. 85-73, Exhibit 782.

[48] Appellate Brief for the United States, p. 172.

[49] *Truman Committee Hearings*, Part 3, p. 931.

However, the Alliance appeared in an official United States list of blocked nationals (Sept. 13, 1944) which included those suspected of having traffic with the enemy and those to whom export would be detrimental.[50]

The Department of Justice asked for a decree enjoining participation by Alcoa or Alted in the Alliance, and dissolving the relation between Alcoa and Alted by redistributing their respective share capitals to two entirely different bodies of stockholders. This petition was denied in the lower court. The final decision by a special appeals court which heard the case in 1945 did not concede that Alcoa had taken part in the Alliance, but it agreed that the 1936 Agreement of the Alliance was intended to, and did, affect American imports. It enjoined Alted from entering into future agreements affecting imports into the United States. (See Chapter X.)

The injunction alone will not guarantee adequate post-war performance of the aluminum industry, although the plan to dissolve Alcoa, unless active competitors acquire the DPC's aluminum plants, will hinder domestic monopoly on which international cartels rest.

Can the break-up of the Alliance assure the world (and the United States) of a stable, plentiful supply of aluminum for peacetime use at reasonable prices? Are supplementary measures needed to bring this about, and to assure the world that no aggressor nation can take advantage of market relations to arm at the expense of its intended victims?

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[50] Appellate Reply Brief for the United States, p. 132.

The Kilgore committee on war mobilization of the United States Senate would replace the cartel system not by unregulated competition, but by international agreements of governments, developing procedures created in the economic dealings among the United Nations in wartime. Its report points out the importance of such action in undermining the " German industrial group. . .the mainstay of the international cartel system ". It calls for the elimination of the aggressive power of German industry by dismantling the direct, and primary indirect, munitions industries (including metallurgy and chemicals) and by removing the indirect group to devastated areas. It would confiscate all German property in the United Nations, including holdings whose identity is masked by so-called " neutral " companies in Switzerland and elsewhere.[51]

WILL SIMPLE TRUST-BUSTING WORK?

The story of Alcoa's international activities since 1896 makes it clear that there have been compelling reasons behind Alcoa's persistent efforts to control its future in the world market by relations with foreign firms. The aluminum industry has created a world market for its product and must think in worldwide terms. Aluminum is transportable, and the industry itself is adaptable to diverse regions of the world, because bauxite and power resources are scattered. As Alted has become a leading factor in the world market, the injunction may not prevent it from seeking to stabilize its world relations; conceivably, it might resort to price warfare in order to get larger quotas in a new cartel agreement. Both Alcoa and Alted have markedly increased their capacity during the war, Alted enjoying the generous assistance of the American and Canadian governments. Both companies must plan how fully, and for what markets, that new capacity may be used after the war. Foreign relations cannot be ignored, especially if domestic demand is insufficient. Other producers in the world face similar problems.

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[51] *Kilgore Report*, pp. 9-10.

The mere breakup of existing agreements will not bring equilibrium, in the face of necessity to trade in a world market, and in view of the large scale corporate organization of aluminum companies in the producing countries. If the Alliance is destroyed, to be replaced by a vacuum, then secret or tacit observance of quotas, combined perhaps with erratic waves of price competition among oligopolies, might result.

PREVENTIVE TREATMENT

However, prophylactic treatment of the cartel problem might be possible in the framework of peaceful international relations and of the economic development of backward countries. Yugoslavia, whose rich bauxite reserves have ordinarily been carried to Germany for processing, may build up an aluminum industry after the war. France and Italy may follow similar programs of industrialization, for both countries, although rich in bauxite, have not developed their aluminum production proportionately, but have allowed the leadership in Europe to pass to Germany. India, with untold reserves of bauxite (still being discovered), with convenient fluorspar for synthetic cryolite, and with only a tiny percentage of its power potential developed, can become a leading aluminum producer. China's abundant alunite can serve as the base of a large aluminum industry, when processes substituting alunite for bauxite are commercially perfected. Potash would be a valuable by-product for Chinese agriculture.

By fostering " interlopers " through technical and financial assistance, or by direct public ownership, if these steps were deemed desirable, postwar governments may be able to weaken the power of the old cartel members, to build up home industries where resources are suitable, and to adapt industrial policy to standards of social performance. Such standards might differ from the cartel aim of reducing risk for the firms which " got in on the ground floor."

Wise international policies in the postwar period will work towards greater world trade. If international demand is broad and stable, the tendency toward drastic restriction of output to avoid the fall of prices below costs may be lessened. If it should be thought desirable to preserve orderly markets by intergovernmental agreements as to prices and production, interests of labor and consumers, as well as those of producers, should be considered.

New processes using aluminum-rich clays such as alunite will also help to free the industry from monopolistic restraints. More firms in each country, as well as more countries, can be drawn into the world supply. But, if past experience is a guide, new processes may not succeed easily without government subsidy of investment and research.

Finally, more magnesium production based on the drawing in of fresh sources of raw materials, of novel processes, and of newly-industrialized countries, will exert a healthy competitive pressure on aluminum monopolies. Government action to prevent aluminum producers from suppressing magnesium may be necessary. Plastics, chilled steel, and other structural materials can serve, along with magnesium, to weaken monopoly power in the world aluminum industry.

CHAPTER VII

MAGNESIUM—LABORATORY BABY

RAW MATERIALS ABOUND

MAGNESIUM is nearly as plentiful as aluminum, being the earth's sixth most abundant element, fourth most abundant metal, and third most common industrial metal (after iron and aluminum). Like aluminum, magnesium is wedded to other elements in compounds: magnesite, dolomite, carnallite, olivine, etc.[1] In the sea, magnesium is the second most important metal; seawater is .13% magnesium. Dolomite is the most abundant magnesium-bearing mineral, and occurs generously in most countries. Magnesite is not so widely dispersed, although plentiful. Olivine is high in magnesium content, and huge deposits near Puget Sound, Washington, may one day be used to smelt the metal in conjunction with Columbia River power.[2]

Before the war, magnesium was produced in the United States from Michigan brines and in Germany from carnallite (a potash-magnesium salt) or magnesite. Now dolomite and magnesite have come into wider use, and unlimited seawater has yielded magnesium economically in the United States (on the Gulf of Mexico), Japan, and possibly Italy. The Great Salt Lake of Utah contains 0.6-3.2% magnesium; in Palestine the Dead Sea too is rich in magnesium chloride which is purified and sold but not as yet used for metal production.[3] The USSR also utilized lake brine for magnesium metal. By-product magnesium salts are turned out in potash and salt operations in New Mexico, California, Texas, and Michigan, and have already been used in producing magnesium.

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[1] Pure magnesite is $MgCO_3$, contains 28.7% magnesium. Pure dolomite is $MgCO_3CaCO_3$, a double carbonate of magnesium and calcium, and comprises 13.8% magnesium. Brucite is $Mg(OH)_2$ and contains 41.6% magnesium. Herbert A. Franke, "Magnesium: Its Production and Use", (the State College of Washington, Mining Experiment Station, *Information Circular No. 36*, April, 1941, Reprinted from *Chemical and Metallurgical Engineering*, March, 1941), p. 4. (Similar publications of the State College of Washington are hereafter referred to as *Inf. Circ.*).

[2] "Magnesium — Newcomer among the Industrial Metals" (*Inf. Circ.* No. 42, August, 1942, Reprinted from *Mining World*, July, 1942), pp. 3-4.

[3] Sir Gilbert T. Morgan and David Doig Pratt, *British Chemical Industry, Its Rise and Development*, London, 1933, p. 25.

Large quantities of magnesite of different grades are found in Washington, California, and Nevada, which also has an estimated 3,350,000 tons of brucite. Dolomite occurs in Ohio, Pennsylvania, Alabama, Illinois, New York, and many other states in large quantities. Serpentine, containing 29.9% magnesium when pure, is available in the United States in enormous quantities, but separation of the magnesium has not yet been worked out on a practical basis.[4]

CONCENTRATION OF OUTPUT

In the face of raw material abundance in America and elsewhere, production of the metal itself is concentrated. From 1927 to 1942 American production was in the hands of one firm, Dow Chemical Company, which is still the biggest factor in the industry. Small magnesium production in France and England was carried on under patent licenses from I. G. Farben, German chief of the small pre-war magnesium industry.[5] Independent Russian production has been going on since the first Five-Year Plan. In Austria and Korea F. J. Hansgirg produced magnesium carbothermically on an experimental scale.

The brines of Midland, Michigan, were the sole source of American-produced magnesium between 1927 and World War II. Dow Chemical Company's control of the industry was temporarily based on its ownership of the Midland brine wells, for other raw materials could not challenge Dow's control so long as methods of processing them were experimental in the

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[4] Franke, *loc. cit.*

[5] Commercial production of magnesium in England started in 1935 through the Magnesium Metal and Alloys Company, Ltd. In 1936 the Magnesium Elektron, Ltd. was organized to produce and fabricate magnesium under I. G. license. Four more companies were formed in 1939 to produce magnesium. United States Bureau of Mines, *Minerals Yearbook*, 1937, p. 729.

United States. The limited size of the magnesium market, gave Dow absolute cost superiority so long as Dow could meet the small market demand with its " waste " by-product of normal chemical operations. A large demand for magnesium (unless accompanied by increased demand for other brine products) destroys the desired balance of joint products and the magnesium monopoly based on raw material control. Wide use of magnesite and especially dolomite would defeat any attempt at monopolizing the industry through ore control, as these minerals are abundant and dispersed. And not even the most ingenious monopolist could corner seawater.

Patents and knowledge of technique were the chief elements in a three-way division of markets and fields of enterprise among Dow, Alcoa, and I. G. Farben. Not one basic patent, but a network of interlocking patent rights, affecting various steps of the young, complex art of electrolysis of magnesium chloride, and of fabrication, alloying, and heat treatment, brought these three important firms together.

Alcoa used patent infringement suits as a weapon to bring Dow to terms, and Dow used its patent power to control the fabrication of magnesium ingot which it sells to foundries. Superior experience of Dow, reflected in expert control of production processes and cost factors, may have helped frighten independent enterprisers away from the industry. But patent protection in a limited market undoubtedly reinforced the " scare " effect decisively, for open licensing of Dow patents under the 1942 consent decree found new firms willing to " take a chance " in the face of an urgent military demand for magnesium.

Better techniques and experience in quality control, particularly in the fabrication of magnesium products, may have created a prestige element in magnesium purchases which protected Dow's market. This element resists evaluation, in view of the other strong factors operating at the same time to defeat competition. The future importance of quality control will depend on how fast fabricating technique is broadly developed in the magnesium industry.

While domination of hydro power sites was closely linked to Alcoa's victories in aluminum control, that factor has not been operative in magnesium. For magnesium has been made on too small a scale to have felt intensely the impact of power costs.[6] In the future, however, magnesium production and pricing will be influenced by the availability and cost of energy, and thus by hydro power needs of the aluminum industry itself.

A large share of the responsibility for the restriction of the magnesium industry can be traced directly to the door of Alcoa, which, fearing that big production would threaten aluminum, took the initiative in approaching Dow and working out a closed system of relations. (See Chapter VIII.)

MAGNESIUM: A FORMIDABLE COMPETITOR?

Three factors help determine the extent to which magnesium can compete with aluminum. One of these is the structure and range of magnesium costs, which will now be examined. The others are the utility and workability of magnesium as compared with aluminum (discussed in Chapter I), and the pricing of magnesium (discussed later in this chapter).

ELECTROLYTIC METHODS

In contrast to the reliance of aluminum production on the Bayer and Hall-Héroult process, magnesium production today is carried on by several alternative methods. Germany, pioneer in magnesium, took magnesium chloride from rich deposits of carnallite, as a by-product of the manufacture of potash, in which Germany led the world. In World War II, an increasing part of the carnallite went into magnesium production rather than into fertilizer, so that magnesium changed from a by-product to the chief product.[7] In Germany, only the great potash combine, Wintershall, and the chemical trust, I. G. Farbenindustrie, produced magnesium. An electrolytic method was used: magnesium chloride bound with water was mixed with sodium chloride or potassium chloride, dehydrated, and separated electrolytically in a fused chlorine bath.[8] I. G.'s Bitterfeld process, based on the extraction of magnesia (magnesium oxide) or magnesium carbonate from Austrian dolomite or magnesite deposits, follows a similar electrolytic route after anhydrous magnesium chloride is prepared.[9] When collected from the electrolytic cell, the metal is alloyed before casting in pig or ingot.

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[6] However, the location of magnesium production near lignite deposits in Germany, near natural gas in Texas, and near the Grand Coulee Dam in Washington would indicate that power costs have already exerted influence on the magnesium industry.

The Basic Magnesium, Inc., plant at Las Vegas, Nevada, controlled by Anaconda Copper Mining Company, has used a British modification of this I. G. Farben method, with some recent improvements developed in America.[10]

The Dow Chemical Company's electrolytic method is based on the recovery of 3-4% magnesium chloride naturally occurring in brines at Midland, Mich.[11] This was formerly a waste, then a by-product, of the production of bromine, caustic soda, and other chemicals. The magnesium chloride is fed into gas-heated, cast-steel electrolytic cells after drying. Magnesium is collected at the cathode. Chlorine and hydrochloric acid left over are used in chemical production. The process is applied to seawater in Dow's plants at Freeport and Velasco, Texas, but it is necessary to concentrate the 0.51% magnesium chloride content of the seawater.[12]

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[7] A. Gurland, *The German Potash Industry: Economic Structure, Wartime Conditions, International Implications*, 1942. An unpublished manuscript, p. 11.

[8] *Inf. Circ. No.* 32, p. 4. Magnesium rises to the surface in globules is skimmed off in batches and purged of impurities, chiefly chlorides.

[9] 77th Congress, United States Senate, *Hearings before the Committee on Patents* (The Bone Committee) *on S. 2303, A bill to provide for the use of patents in the interest of national defense or the prosecution of the war, and for other purposes,* Part 2, April 20-25, 1942, Exhibit 10. (Exhibits from the same source are hereafter referred to as *Bone Exhibits.*)

[10] Magnesite ore is roasted to yield magnesia. This is crushed into a powder, mixed with crushed coal, dampened with magnesium chloride, briquetted, dried, and dumped into a chlorinator furnace. Anhydrous magnesium chloride emerges, is fed into an electrolytic cell, and decomposes into magnesium and chlorine. A steel cell lined with ceramics is used. Floating magnesium is ladled by hand under a fire-preventing flux off the top of the electrolytic bath to cool into a "cheese" mold. The chlorine is continuously piped off as gas at the anode. *Life*, January 10, 1944, pp. 55-60; "Magnesium by the Ton", *Fortune*, March, 1944, pp. 184, 187.

[11] The Dow Chemical Company, founded by Dr. Herbert Dow, was incorporated in Michigan in 1897 to build a bleach plant at Midland, using the

NEW THERMAL METHODS

Alternative to the electrolytic method applied to magnesium chloride from magnesium ores are several variants of the

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waste liquors of the Midland Chemical Company. The Dow Company bought up the Midland Chemical Company and The Dow Process Company, both also founded by Dr. Dow. In 1928, the Dow Company formed the Jones Chemical Company, Inc. (absorbed as Io-Dow Chemical Company by the parent in 1939) to manufacture iodine from brine wastes of Louisiana oil fields. Other corporate proliferations of Dow included Dowell, Inc. (formed 1932 to service ore and gas wells under Dow patents), Ethyl-Dow Company (formed 1933 together with Ethyl Gasoline Corporation, owned jointly by the General Motors and Standard Oil of New Jersey to make bromine used in ethylene dibromide), Dowell Sociedad Anonima in Mexico (formed 1935, functions analogous to those of Dowell, Inc.), Midland Ammonia Company, maker of synthetic ammonia (Dow owns 75%), Dow Chemical of Canada, Ltd. (formed 1942 to manufacture styrene), and Dow Magnesium Corporation, formed October 31, 1941, to run Dow's magnesium plant at Freeport, Texas. The basic products of Dow's 125 brine wells scattered for thirty miles west of Midland include: bromide, magnesium chloride (Epsom salt), sodium chloride yielding caustic soda and chlorine. Numerous chemical derivatives prepared by Dow from these, plus natural gas and crude oil, serve at least twenty industries, and are often used as bases or components of other products. 1942 assets of the Dow Company totalled $103,000,000 compared with $29,000,000 in 1936, and the 1942 post-tax income of $9,220,000 was the highest in the history of the corporation. From 1926 until 1942 Dow was the only producer of magnesium metal in the United States. (*Moody's Manual*, 1943, pp. 34-7.)

[12] This is done by crushing and calcining oyster shells (calcium hydroxide), with which seawater is mixed in tanks to yield magnesium hydroxide. The sodium chloride brine is processed in electrolytic caustic soda cells and gives up chlorine used to make hydrochloric acid. The acid is applied to the magnesium hydroxide to yield magnesium chloride in a concentrated (35%) solution. Walter J. Murphy, "Magnesium from the Sea ... An Epoch-Making Achievement", *Chemical Industries*, XLIX, 6, November, 1941, p. 621.

thermal production of magnesium from such ores. When magnesia from magnesite or dolomite is heated with carbon at high temperatures magnesium vapor is liberated, condensed upon chilling, and purified by distillation. Dr. F. J. Hansgirg is responsible for this method, using hydrogen to shock-cool the magnesium vapor. He installed his process at a pilot plant in Radenthein, Austria, and later in a Japanese-American plant in Korea.[13]

Operating under the Hansgirg patents, one unit of the Permanente, Calif., magnesium plant of the Henry J. Kaiser interests used natural gas in place of hydrogen and petroleum coke as the carbon instead of anthracite. Other units used hydrocarbon oils replacing hydrogen but many practical difficulties were met.

Other variants replace the carbon reduction agent with aluminum, silicon (or ferrosilicon) or calcium carbide, all of which, unlike carbon, produce non-gaseous oxides, releasing only one vapor—magnesium—and dispense with shock-cooling.

A ferrosilicon process developed in Canada was recommended by the National Academy of Sciences for emergency wartime use, as the plants are easy to build, raw materials abound, and power consumption is low (6 kilowatt hours per pound of magnesium—as compared with 11 kilowatt hours by the Hansgirg method, and 10 by chloride electrolysis—exclusive of the energy needed to purify the raw material).[14] The Ford magnesium plant uses dolomite from Michigan quarries. The lime residue from the dolomite is potential fertilizer. Ford believes that of all the methods, the carbothermic process offers most promise for permanent use, as the price of ferrosilicon ($135 a long ton in 1944) adds 6c a pound to the final cost of magnesium.[15]

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[13] Established by the Nippon Magnesium Metals Co., formed by the American Magnesium Metals Corp. (of which Hansgirg was an officer) and Nippon-Chisso, a Japanese fertilizer concern. F. J. Hansgirg, "Thermal Reduction of Magnesium Compounds", *The Iron Age*, November 25, 1943, p. 54.

[14] H. A. Doerner, *Magnesium, Present Outlook for a Magnesium Metal Industry in the Northwest and a Discussion of Methods by which Magnesium Metal may be Obtained from Magnesite Ores*, The State College of Washington, Mining Experiment Station, Bulletin P, March, 1943, p. 24.

In 1936 the Bureau of Mines began studies on the concentration of low-grade magnesite ores to permit magnesium production in Washington, and on improvements in the carbothermic reduction of magnesium from magnesite by the so-called Doerner process. Carbon is by far the cheapest of all the thermal reducing agents, but alone requires shock-cooling of the metal into powder and therefore takes an extra step (distillation) to get a pure massive metal. Carbothermic reduction has many more operating " bugs " than the older electrolytic method.

Diamond Magnesium Company used the Dow electrolytic process on magnesium chloride recovered along with ammonia from calcined dolomite added to soda ash liquor. Mathieson Alkali Works used soda ash liquor and dolomite to make magnesium chloride by a somewhat different process. International Minerals and Chemical Corporation made magnesium chloride from dolomite by treating it with hydrochloric acid, using extra magnesium chloride from a New Mexico potash plant.[16]

Methods of magnesium production in 1944 ranked as follows in relative importance: electrolysis of magnesium chloride from brine and seawater (Dow) accounted for 34% of the planned capacity for 1944; electrolysis of magnesium chloride prepared from magnesite and dolomite, 38% (Basic, Mathieson, Diamond, International); thermal reduction of dolomite by ferrosilicon, 24% (Permanente, Ford, Electro Metallurgical Company—a subsidiary of Union Carbide and Carbon Company, New England Lime Company, Amco Magnesium Corporation—a subsidiary of American Metals Company, Ltd., Magnesium Reduction Company—a subsidiary of National Lead Company). Carbothermic reduction of magnesium from ores at Permanente accounted for only 4% of the total capacity.[17]

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[15] " Magnesium by the Ton ", *loc. cit.*, p. 194.

[16] *Ibid.*, p. 188.

[17] *Ibid.*, pp. 181, 194, 196.

THE ROLE OF BY-PRODUCTS

All methods integrate magnesium production with the production of some other chemical, although the latter may be wasted. Magnesium is a by-product up to the market saturation point of the principal product. After that point is reached, magnesium should bear most of the overhead cost and the other product becomes secondary. The I. G. Farben method based on carnallite obtained magnesium chloride as a by-product of potash production, until war needs of magnesium alloys forced a shift in emphasis. Dow's brine-based method permitted a low raw material cost of magnesium chloride, until the war demand for magnesium outran the demand for other brine constituents, and led Dow to set up its Freeport plant to meet the British (and later, American) need for magnesium. Even at Freeport, however, seawater yields not only magnesium, but also commercial chlorine and other chemicals (in combination with elements from large local deposits of gas, petroleum, rock salt, and sulfur).[18]

The three alkali producers who entered the magnesium field using the Dow electrolytic method employed waste liquors from soda ash production and potash operations. Diamond got commercial lime as well as magnesium from dolomite.[19] Permanente sold burned magnesia and carbon ("black magnesia"), by-product of the carbothermic process, to the rayon, refractories, and synthetic rubber industries. Hydrogen, sodium hydroxide, and residual salt wasted in the Basic plant could be recovered and re-used in the plant or sold.[20]

By-products or joint products lower the share of overhead cost borne by magnesium, up to the stage where magnesium chloride or magnesia departs from the joint production stream to be made into metal, as independent facilities are then required. Dow's predominance in American magnesium production is largely based on this fact. No other method could compete effectively with electrolysis of brine when Dow could regard magnesium chloride as a costless waste product of its major chemical operations.[21] In bargaining with Alcoa and I. G. Farben for market control, Dow threatened to cut its accounting costs for magnesium choride to zero—giving a price-cutting margin of 5c a pound—in case I. G. began production of magnesium in the United States.[22] Dow could enjoy this freedom only so long as the magnesium market was small enough to be supplied entirely by Dow's by-product flow of magnesium chloride. After that point, the advantage of having magnesium as a by-product was limited by the scope of the market of the other joint products. Foreseeing a market for magnesium greater than that for other brine elements, Dow might use Michigan dolomite or magnesite as a raw material; in fact, Dow was reported in 1929 to have experimented in a chloride process based on magnesite.[23]

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[18] Murphy, *loc. cit.*

[19] 78th Congress, 2nd Session, Senate Report No. 10, Part 17, *Additional Report of the Special Committee Investigating the National Defense Program, pursuant to S. Res. 71, Magnesium,* March 15, 1944, p. 13. Hereafter referred to as Truman Report on Magnesium.

[20] Robert H. Ramsey, "Magnesium Production at the World's Largest Plant", *Chemical and Metallurgical Engineering,* October, 1943, p. 100.

JOINT COSTS AND PRICE POLICY

The producing firm is forced to consider stabilization of the market for all the joint products in order to dispose of the entire production flow without waste. Price-cutting in the market for one of the products is made economically possible by oligopoly or monopoly in the main product—an inter-product dumping analogous to international dumping. As an alternative to price-cutting, the firm has strong reasons to make cartel agreements dividing industrial spheres so that it accepts a minor share of the market for one of its joint products in return for majority control over another. The relations of Du-Pont, Imperial Chemical Industries, Ltd., and I. G. Farben, and of Standard Oil of New Jersey and I. G. Farben, are honeycombed with such provisos.[24] Dow took a backseat on the world market for magnesium by permitting I.G. to " retail " the bulk of Dow exports. In 1944 Dow was charged with being a member of a national alkali cartel, United States Alkali Export Association, Inc., which divided the world market with Imperial Chemical Industries, I. G., and Nazi-controlled Solvay et Cie.[25] Competition in bromine and bleaching agents involved a clash between Dow and the German chemical industry before the first World War, resulting in an unsuccessful price war on the part of the German bromine cartel. The Diamond and Mathieson Companies were named as co-defendants with Dow in the alkali indictment. These cartel agreements depended on the joint-product structure of the chemical industries.

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[21] "In general no brine, bittern, or natural salt can be regarded as a source of magnesium unless the magnesium salt is a by-product from a process used to recover one or more of the other constituents". Doerner, *op. cit.*, pp. 8-9. A bittern is a brine concentrated by evaporation until much of the sodium chloride is crystallized.

[22] *Bone Exhibit 8.*

[23] *Bone Exhibit 7.*

The electrolytic cells used in making aluminum are not interchangeable with those used in making magnesium because magnesium floats (being lighter than the electrolyte), while aluminum sinks and is tapped from the bottom of the cell. But in fabrication by rolling, casting, extrusion, etc., many facilities are interchangeable. Alcoa's Cleveland aluminum foundries have also turned out magnesium castings. Distribution and sale of both by the same sales offices appeals as a source of economy. In fact, Alcoa salesmen have retailed to metal-using firms magnesium products made from Dowmetal ingot. Dow complained, however, that Alcoa's personnel were reluctant to push magnesium as a substitute for aluminum. I. G. too noticed this reluctance, as shown by its desire for an independent sales outlet for a planned Alcoa-I. G. magnesium production plant.[26] But if the expected market were great enough to absorb both, systematic promotion of a " line " of light metal alloys by a single advertising or distributing organization would be practical.

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[24] 78th Congress, 2nd Session, United States Senate Committee on Military Affairs, Monograph No. 1, *Economic and Political Aspects of International Cartels*, Washington, 1944, pp. 3-8.

[25] Complaint filed March 16, 1944, in the District Court of the United States for the Southern District of New York, United States of America, Plaintiff, v. U. S. Alkali Export Association, Inc., et al., Section V.

Magnesium production (by any of the processes used) entails a heavy investment in metallurgical equipment, even if there is little outlay for raw material sources such as ore deposits or brine wells. Entry into the industry is restricted, on this account, to firms well-stocked with capital, or deriving income from the sale of a by-product, or aided by government subsidy of the threshold investment (such as Defense Plant Corporation expenditures). Total government investment in thirteen war plants (exclusive of $116,000,000 advanced for operating expenses) was $370,000,000. An additional sum of $15,000,000 was invested by the government in fabricating facilities.[27] The high level of fixed costs, a monopoly-protecting characteristic of magnesium production, has been attacked by subsidy, and ten new firms turned the Dow solo into a chorus. Whether they can stay or not depends on the policy of the government in disposing of its investment, and on the postwar demand.

Because most magnesium production, especially before the war, was carried on by chemical rather than metallurgical concerns, fabrication has not been well integrated with production. Small independent fabricators buy ingot. Although Dow fabricates part of its production, it sells a large portion to American Magnesium Corporation, Alcoa's subsidiary, to be finished. The fact that most other wartime producers are ill-integrated into fabrication weakens their survival ability, as they lack experience in the youthful art of working magnesium alloys, and will be handicapped in promoting magnesium products.

Costs of producing magnesium are already low enough to make the metal competitive with aluminum, even if the price of aluminum should drop to 12 or 13c, and will be lower as the carbothermic method is improved. The ferrosilicon process is uneconomical.[28] Although this and the calcium carbide method require lower temperatures than carbic reduction, they both represent a prior power investment in embodied heat whose cost raises fuel requirements. Both use a low-efficiency open furnace, while the carbon method uses a special high efficiency furnace. A developed carbothermic process, Hansgirg feels, could cut the cost of magnesium to 10c a pound, which would make it a competitor of steel on an equal strength-weight basis if the other properties were similar.[29]

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[26] *Bone Exhibits 8, 17.*

[27] *Truman Report on Magnesium,* pp. 11, 54.

Dow's seawater production, using cheap natural gas and a cheap raw material, cost about 16-18c a pound including fixed charges of 3c.[30] Dow's privately-owned plants have sold magnesium at 20½c but the cost is undoubtedly a few cents less.[31] After a history of poor planning and management, (see below, pp. 228-31), Basic Magnesium costs were pared down to 23½c a pound by November, 1943, before amortization of plant facilities of over $129,000,000. Redesigning of plant may reduce the cost and make Basic metal competitive with seawater magnesium. This depends on sufficient hope of a great market to justify continued investment in the world's largest magnesium plant, as no by-products are yet produced. International and Diamond recorded a cost of 20c.[32]

In light metals, and particularly in magnesium, we find little evidence of a " natural " level of costs. The future cost structure depends on government policy as to the disposal of its wartime investment in production facilities, and as to the pricing of power from publicly-owned projects. Further power developments (e. g., the long-delayed St. Lawrence project) will also influence both the cost of electrochemical products and the number of producers.

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[28] *Ibid.*, p. 20.

[29] Hansgirg, *loc. cit.*, p. 58.

[30] An estimate of 12.4c. a pound at the Velasco, Tex. plant of the DPC run by Dow probably omits amortization of plant facilities. *Truman Report on Magnesium*, p. 50.

[31] W. C. McIndoe, Chemical Engineer of the Bonneville Power Administration, told the Truman Committee: "...it is extremely difficult to get any data on the Dow Chemical process. They just don't talk for publication". 77th Congress, 2nd Session, *Truman Committee Hearings*, Part 13, March 9-24, 1942, Subcommittee on Aircraft and Light Metals, p. 5448.

[32] " Magnesium by the Ton ", *loc. cit.*, p. 188.

Costs also reflect the policy of the dominant producer (Alcoa in aluminum, Dow in magnesium) as to the level of investment and prices. Unless demand increases, large investments which bring about cheaper mass production will take place only if the firm expects and wants to sell the added output at lower prices. In the case of magnesium, the development of new methods has waited on the assumption of risk and capital burden by the government, the guarantee of a steady military market, and the loosening of international patent and cartel controls.

This process is cumulative, as the increase in production, which has followed a wider foraging for raw materials and their use by new methods, has made magnesium more familiar to industrial users. It has also led to experimentation in its fabrication and use, and has provided hope of markets which may spur on research in new methods. The fostering of research has involved policy decisions by private firms. All of this underlies the statement that there is as yet no " natural " level of magnesium costs. Perhaps several methods will be simultaneously used in the future (as in the alkali industry), each depending on joint products for economy of operation.

But lack of a postwar market could nip in the bud the extra experimentation needed to improve one or more of the currently used methods. If several independent enterprises remain in the field, and buyers will not have to deal with a monopoly, the postwar demand for magnesium may be large as compared with the pre-war demand, for buyers will not fear to substitute magnesium for other materials. Of course, this point strikes home in aluminum consumption as well. The demand, the number of firms, and the level of costs are interrelated.

CHAPTER VIII

THE STRATEGY OF MAGNESIUM CONTROL

MAGNESIUM is the closest substitute for aluminum yet discovered. As an aluminum monopolist, Alcoa was quick to realize the dangers of a magnesium industry which would compete effectively on a large scale with Alcoa's product. Able to gain a foothold in the magnesium industry, Alcoa had the choice of promoting the perfection and mass production of magnesium, making some of its investments in aluminum worthless, or of retarding the growth of the magnesium industry in order to safeguard the aluminum monopoly.

THE BEGINNINGS OF THE MAGNESIUM INDUSTRY

In the United States, the magnesium industry is a twentieth century baby. Germany, building on the work of Robert Bunsen, who in 1852 produced magnesium by electrolyzing fused (melted) magnesium chloride in a porcelain crucible, was the world's leading producer. About thirty years after the first electrolytic magnesium plant was built in Germany in 1886, France, England, and the United States entered the field for military reasons. The General Electric Company at Schenectady, New York, began making magnesium in 1915, and was followed by a number of other firms between 1915 and 1918.[1]

Magnesium commanded a high price ($5 and more in 1915 for a pound of ingot). It was used chiefly in powdered form for pyrotechnics such as flares, rockets, and tracer bullets. After the war, until alloys were developed for structural uses, magnesium was mainly known to the lay public as the source of flashlight powder used in photography and to industry as a deoxidizer in nickel metallurgy.[2]

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[1] Norton Laboratories at Nashua and Lockport, N. Y., Electric Reduction Company, New York City, Shawinigan Electro Metals Co., Ltd., Shawinigan Falls, Canada, Aviation Materials Corp., Niagara Falls, N. Y., The Magnesium Manufacturing Corporation, Rumford, Me., American Magnesium Co., Niagara Falls, N. Y., and Dow Chemical Co., Midland, Michigan. John A. Gann, "Magnesium, Reviewing Its Technology of Production and Use", *Mining and Metallurgy*, April, 1932, p. 1.

Some of the pioneer firms dropped out as the demand for magnesium fell to ⅓ of the wartime need; two others were absorbed by the American Magnesium Company (AMC) at Niagara Falls, N. Y. Alcoa became a magnesium producer when in 1919 it acquired a majority of AMC stock. In 1920 the Dow Chemical Company and Alcoa (through AMC) were the only companies left in the field. By 1924 AMC had become a 100% subsidiary of Alcoa.

DECISIVE FACTORS AFFECTING DOW AND AMC

Dow's main business was the production of pharmaceutical and industrial chemicals. Dow owned brine wells in the region of Midland, Michigan, which contained .75% magnesium chloride, found in conjunction with sodium bromide, calcium, and sodium chlorides. Before 1914, magnesium was merely a wasteproduct in Dow's production of bromine salts and other chemicals, and to boot an expensive liability. To avoid contaminating the water supply of neighboring communities, Dow had the expense of disposing of the magnesium chloride.

In 1914 the interruption of German imports of magnesium chloride threatened to stop production of magnesium oxychloride cements in the United States. Dow began to produce magnesium chloride commercially. This led to experiments with magnesium metal, Dow's first venture outside the chemicals field.[3]

Although AMC, the other magnesium producer, had the benefit of Alcoa's experience and facilities in the alloying, fabrication, and promotion of aluminum, Dow had other and perhaps more strategic advantages. Magnesium was for Dow a by-product of Dow's major chemical activities, involving little extra overhead.[4] Sale at almost any price was preferable to costly disposal of a waste material. Dow's efficiency in chemical processes and the proximity of the plant to the raw material kept operating costs down as compared to AMC, which used western magnesite. The Dow process used less electricity than AMC. The purity of the magnesium chloride permitted the production of a pig metal which contained substantially no impurities except copper.

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[2] To make nickel malleable enough for fabrication by mechanical working. Gann, *loc. cit.*, pp. 3-6. This was an important war use. Magnesium was called a deoxidizer, but its real use was to " fix " any sulfur present.

[3] Dow Chemical Company, *44th Financial Report*, For Year Ended May 31, 1941.

Dow might therefore be expected to take an interest in extending its magnesium business.[5] Dow lost about $500,000 in the first decade of production, owing to initial failures in devising and applying new processes of production and alloying, and to foreign competition. The Fordney-McCumber Tariff Act of 1922 imposed a duty of 40c. a lb. on metallic magnesium, and 40c. on magnesium alloys plus 20% ad valorem. Competition with AMC, lower production costs, and the desire to expand the market forced the price down from $1.60 in 1920 to 55c. in 1927.[6] Only then did magnesium show signs of becoming a commercial metal. In 1922 for the first time Dow sold magnesium alloys ("Dowmetal") in the form of castings. Its early sales had been chiefly ingot, but now Dow tried to bring a fabricated product to market, since independent fabricators were lacking and AMC, Dow's competitor, was producing fabricating alloys. In 1920 and 1921 Alcoa had succeeded in persuading some automobile manufacturers to use aluminum alloy pistons, and Dow, wishing to compete in the piston field, attempted to perfect the casting and machining of pistons. Meeting the old prejudice of the manufacturers about the inflammability of magnesium, Dow turned to the replacement business, as pistons then lasted no longer than 10,000 miles. The cost of production and distribution was high. Dow also promoted resonators in automobile horns, and portable tools.[7]

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[4] Until the market for magnesium became so large that other brine constituents had to be simultaneously produced in excess of their normal markets. *Bone Exhibit 7.*

[5] However, Dr. Herbert Dow, late president of the company, was personally not "metal-minded" in spite of his part in the development of magnesium. He apparently regarded the metal as a specialty to be sold to a "selected clientele". *Bone Exhibit 8.*

[6] Price quoted to AMC on December 15, 1926. *Bone Exhibit 1.*

THE LARGER ROLE OF AMC

AMC meanwhile was producing magnesium by thermal reduction of magnesite. The magnesium was used by the parent company, Alcoa, as an alloying ingredient in aluminum-base structural alloys. AMC could therefore become a reliable source of material for intra-company consumption. But AMC also had a larger role—it was a potential sharer in any future market for structural magnesium, which might threaten the aluminum market. As a consumer of magnesium, Alcoa benefited from improved processes and lower prices—until the point was reached where Alcoa, as an aluminum monopolist, felt the inroads of a competitive material. This point was brought dangerously near by Dow's price reductions from 1923 to 1926. As soon as alloying and fabricating techniques could be perfected and the market cultivated, magnesium would endanger Alcoa. Magnesium weighs ⅔ as much as aluminum of equal volume; if magnesium sold at any price less than 3/2 (150%) of aluminum prices, it could compete actively with Alcoa aluminum.[8]

Alcoa therefore had a material interest in controlling Dow's production and price policy, and in becoming the sole distributor of fabricated magnesium products to industry.

If magnesium did become profitable, Alcoa wanted to participate in the earnings. But Alcoa hesitated to struggle with Dow for control of magnesium sales. Its process was still imperfect; Alcoa's costs per pound of magnesium in 1927 were 43c. (excluding factory overhead) as compared with Dow's cost of 22.5c. The grade of AMC metal was relatively low. Although Dow and Alcoa had spent equal sums on developing magnesium, Dow had concentrated its spending on primary production, whereas AMC had spread its efforts over production, alloying and fabrication. The results showed up in Alcoa's inferior primary production. AMC, at Niagara Falls, was located far from its raw material—western magnesite. AMC believed its problems could be solved, for the thermal reduction of magnesite, if perfected, was thought to be inherently cheaper than the brine process of Dow. AMC had certain advantages. Through integration with Alcoa, AMC gained access to Alcoa's sales outlets—*if* Alcoa decided to promote magnesium sales, however—and to Alcoa's experience and research in alloying and fabrication. But these long-run potentialities yielded to the immediate objective—to prevent price competition in the American magnesium market which would adversely affect Alcoa's aluminum investments, and, by a tie with Dow, to strengthen Alcoa's hand in dealing with German efforts to export magnesium to the United States or to produce it here.[9]

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[7] "Dow and Magnesium", The Dow Chemical Company, Midland, Michigan, 1944, pp. 12-13.

[8] True only for ingot. Variations in fabricating costs, especially in these early days when magnesium fabrication in the United States was imperfectly developed, impair the concept of "volume parity" in prices beyond the ingot stage.

THE 1927 PURCHASE AGREEMENT

With these considerations in mind, AMC, which had been buying some magnesium from Dow since 1926, negotiated a purchase agreement in 1927, whereby AMC bought all its magnesium requirements from Dow and ceased producing magnesium metal. The first contract ran for 18 months, and a new 5 year contract was made in 1928. The prices paid by AMC were below those received by Dow from other customers, and were scaled downward as Dow's total sales increased.[10]

The two companies also signed a cross-licensing agreement on March 4, 1927, referring to fabrication and alloying patents

[9] *Bone Exhibits 1, 4.*

[10] *Bone Exhibit 33.*

which had been involved in a dispute in the United States Patent Office. AMC was permitted to use Dow patents only on magnesium bought from Dow. Each agreed to require sublicensees under these pooled patents to use the patented processes only on magnesium bought from Dow or AMC.[11] The disputed patents referred to heat-treatment of magnesium alloys, but the agreement covered also extrusion and forging methods. By another agreement, on July 15, 1927, Dow granted AMC a non-exclusive license to use a Dow casting patent, but only on metal bought from Dow.

THE PISTON MYSTERY

Dow withdrew from the lucrative production of magnesium powder about this time, leaving the field to AMC. Dow's 1941 financial report mentions that in the early 1920's "...many thousands of Dowmetal automobile pistons...were successfully used by thousands of customers ". Yet Dow did not develop this field—nor did AMC. At the time of these agreements with Dow, Alcoa was allegedly using patents covering the manufacture of aluminum pistons to prevent independent production of aluminum pistons. Alcoa allegedly used its power to sublicense under various patents so as to limit the quantity of pistons manufactured and to require aluminum for these pistons to be bought from Alcoa only.[12] If Alcoa was protecting its production of aluminum pistons against the competition of independent aluminum fabricators, it may have wished to prevent competition from magnesium pistons when the 1927 agreements were made with Dow. High prices for magnesium could have served this purpose. There is no evidence of specific agreements on pistons between Dow and AMC. (See below on role of price policy.) The Dow pistons may have been unsatisfactory without further research, and slow to find a market. But Dow did not aggressively cultivate the market or push improvements in the product.

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[11] Indictment No. 109-191 (Criminal), In the District Court of the United States for the Southern District of New York, United States of America v. The Dow Chemical Company, et al., Returned January 30, 1941, p. 10.

[12] Equity No. 85-73, Brief for the United States, December 2, 1940, pp. 486-94.

By the 1927 agreements, the two magnesium enterprises were brought into a community of interests which was not, however, a complete union. The licenses granted by each to the other were not exclusive and could be extended by the grantor to third parties.[13] Dow could still fabricate magnesium and could sell ingot to other fabricators. AMC, while required to buy 250,000 lb. of magnesium a year, and at least 1,500,000 lb. in 5 years under the 1928 contract, could return to magnesium production or import if it wished. But it did neither. By buying ⅔ of Dow's output and by assuring Dow of a steady market in magnesium to be used in alloys, Alcoa enjoyed a preferential price. By securing control of magnesium fabrication and distribution Alcoa was able to delay promoting magnesium in competition with aluminum alloys. Dow realized this, and indeed complained in 1929 that Alcoa wasn't "putting quite enough effort on the development of the magnesium business". Wrote one of Alcoa's staff,

> Dow is inclined to think of us as standing beside the band wagon waiting for the band wagon to show trend and direction. If the band wagon goes strong then we step aboard; if it does not... we stand to lose little. *And that size-up is not far from right* (Italics supplied)[14]

THE THREAT OF I. G. FARBEN

The next problem Alcoa faced was how to handle the threat of possible sales and production of magnesium in the United States by I. G. Farbenindustrie. It was Alcoa, more than Dow, which had urged the government to place a tariff on magnesium. The Elektron Metals Corporation, formed by the Griesheim interests, had unsuccessfully attempted to invade the

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[13] *Bone Exhibit 5.*

[14] *Bone Exhibit 8*; see also *Bone Hearings*, part 2, p. 958.

American magnesium market in 1925. Griesheim was one of the firms which merged on December 9, 1925, to form I. G. Farbenindustrie.[15] About this time (1926) Alcoa was arranging with Vereinigte Aluminiumwerke (connected with I. G. through their joint selling agency, Metallgesellschaft) to keep German aluminum from injuring Alcoa's home market control.

I. G. wished to profit on its investments in magnesium research but was aware of the difficulties of entering the American market alone and in the face of the tariff. It hoped to join with a " native " American company in a magnesium enterprise. I. G. made contact with Alcoa after sounding out Dow and other companies. Dow was unreceptive to I. G. because I. G.'s patented processes were competitive with, not complementary to, Dow's. On the other hand, I. G.'s patents complemented Alcoa's. I. G. used as a selling point with Alcoa the " trustworthy position " which I. G. established with Standard Oil. Alcoa was impressed by this. Wrote H. E. Bakken, superintendent of Alcoa's magnesium operations:

> [If Alcoa combines with I. G.] we are assured of a partnership which has a background and experience representing the pick of continental Europe . . . the opportunity of this combination may lead to other combinations which may place us in a position to occupy even a more important place than we now occupy in the industry of the world.[16]

Both parties regarded an entente in magnesium as a mere prelude to wider spheres of coöperation.[17]

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[15] Chemische Fabrik Griesheim-Elektron, Frankfurt a.M. had begun magnesium production on a large scale at Bitterfeld in 1896. Joseph Borkin and Charles A. Welsh, *Germany's Master Plan, The Story of Industrial Offensive,* New York, 1943, p. 325.

[16] *Bone Exhibits 8, 10, 33.*

[17] Walter Duisberg, son of the founder of the German dye trust, and American representative of I. G. in magnesium, wrote to I. G.'s home office in January, 1933: "Alcoa is anxious to have the closest possible cooperation with I. G. and we believe it would like to see the cooperation extended to other fields as well". *Bone Exhibit 27.*

THE INDEPENDENT SURVEY

After S. K. Colby of Alcoa and I. G. agent von Rath had discussed an " entente cordiale " and their " mutual interest in the manufacture of metallic magnesium to which. . .Dow must be a party ", I. G. and Alcoa agreed to hire an independent electrochemical engineer to visit Dow's Midland plant and I. G.'s plant at Bitterfeld, Germany. He was to report to " the three parties in interest only the difference in cost of production in cents per pound. . .if magnesium were made under I. G. processes in the United States." I. G. hopes of a rapprochement depended on the expert opinion that its process " was both technically and commercially superior to that now used in the United States." [18]

The survey compared both production and fabrication techniques. It concluded that I. G.'s electrolytic process was inherently superior to Dow's, and could be used in the United States to produce magnesium at least as cheaply.[19] Dow was able to compete because of the low price which it charged itself for magnesium chloride.[20] Also, I. G. was more advanced in fabrication technique than either AMC or Dow, because of the larger and older market for magnesium products that existed in Europe. The report urged that the combination of the " specific advantages " of the three companies " would be commercially more profitable than any one or even two working alone " [21]

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[18] *Bone Exhibit 6.*

[19] I. G. produced magnesium from Stassfurt carnallite and from Austrian magnesite. It prepared magnesium chloride by " reacting on the magnesite ores with chlorine in the presence of a carbonaceous material " and then electrolyzed the magnesium chloride in cells of its own invention. *Bone Exhibit 7.*

[20] Dow's production cost at the rate of 5,000,000 lb. a year was 17c. a lb. excluding general overhead, as estimated by Bakken of Alcoa in 1930, but was about 30c. a lb. with a production of under 1,000,000 lb. The I. G. process in the United States, he estimated, would cost 15.4-18.5c., competitive with Dow capacity production. *Bone Exhibit 33.*

[21] *Bone Exhibit 7.*

DOW'S ATTITUDE

In December, 1929, Dow and Alcoa discussed a combination with I. G. Dow refused to be a part of a corporate combination with I. G., but was willing to consider some looser tie. Dow expected to meet competition by so arranging its " cost distribution as to make no charge for magnesium chloride that enters into the process ".[22] Dow and Alcoa discussed plans for coöperation without I. G. Dow did not want to set up a joint magnesium subsidiary but was willing to continue the previous relation (preferential purchase, and patent licensing agreements) " though in a much more purposeful and definite manner ". As Dow's current annual brine flow could produce 5,000,000 lb. of magnesium, Alcoa was willing to permit Dow to " exploit that production without interference ". If the business exceeded 5,000,000 lb., Alcoa was " interested not only in fabrication but also in production "—i. e., when magnesium threatened to compete on a large scale with aluminum, Alcoa wanted to get profits on magnesium production to compensate for a smaller aluminum market.[23] Until that time, Alcoa planned to " buy metal as a preferred customer and continue development of its use ".

THE ALIG AGREEMENT

I. G. and Alcoa went ahead with negotiations on a joint American company to produce and fabricate magnesium. The new company, owned in equal shares by Alcoa and I. G., was to be assigned all their American patents and processes relating to magnesium. It would build a plant for the production of ingot to sell under license to outside foundries, and would fabricate part of the metal with its own equipment (largely Alcoa's facilities) into finished products "including the low-priced automobile castings".[24]

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[22] In 1929, the largest electrochemical company in France, Société D'Electro-Chemie, Métallurgie, et des Aciéries Electriques had sent representatives to Midland and had negotiated the purchase of Dow's French patents and technique. (The first installment was paid July, 1929, but owing to the depression, production plans were abandoned and the contract was terminated in 1931.) Dr. Dow took the episode as "conclusive proof" of the superiority of Dow methods. Dr. Herbert H. Dow died in October 1930 and was succeeded by his son, Dr. Willard H. Dow. "Dow and Magnesium", pp. 16-17.

[23] *Bone Exhibit 8.*

Over I. G.'s protests, production plans were temporarily scrapped, for Alcoa wished to continue buying metal from Dow, thereby getting the right to use Dow patents in heat-treating magnesium-base alloys. Then I. G. and Alcoa set up a joint company to hold their magnesium patents—the Magnesium Development Corporation (MDC). I. G. agreed not to fabricate magnesium in the United States in competition with Alcoa, the chief fabricator. The so-called Alig agreement, dated October 23, 1931, and effective for 20 years, set up the MDC in Delaware.[25] I. G. and Alcoa conveyed to MDC all United States patents and technique relating to magnesium,[26] with the right to sublicense in the United States only. This protected I. G. by preventing Alcoa from licensing foreign competitors of I. G. Each party received 5,000 shares in return for patents and a cash subscription of $50,000, and as additional compensation for its patents I. G. received a claim of $1,000,000 against the future earnings of MDC. Each could receive royalty-free licenses under MDC fabrication patents (i. e., from each other). MDC would license outside *fabricators* at a minimum royalty of ½c. per lb. of magnesium, and could, by majority consent, issue *production* licenses at a minimum royalty of 1c.[27] Outsiders getting licenses had to assign to MDC title to any magnesium patents developed by them during the life of the license. The agreement allowed for future magnesium production. Neither Alcoa nor I. G. was to organize a production company without permitting the other to participate, and the " initial contemplated production capacity " was limited to 4000 tons a year.

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[24] Alcoa, Tenn. was suggested as a possible location for the metal plant. Although magnesite was concentrated in the western states, lack of markets and labor there led Alcoa to favor an eastern location. At this time, the Columbia River power projects were not yet completed. *Bone Exhibits 10, 33.*

[25] The working office was planned for New Jersey, where Alcoa had plants, but the actual work was to be done at I. G.'s New York headquarters, the office of the U. S. and Transatlantic Service Corporation. *Bone Exhibits 10, 12, 14.*

[26] Except that Alcoa reserved control over patents relating to piston castings by permanent or semi-permanent mold processes. *Bone Exhibit 13.*

DOW ATTEMPTS TO COMPETE

Meanwhile, in 1930, Dow had organized a special sales division to handle magnesium and its products, capitalizing on the interest shown at the National Air Show in Detroit, where magnesium crankcases had been displayed in several airplane engines. Dow did not try to fabricate, but licensed a few fabricators, loaned them technicians, and did special research for each fabricator. The Ford Motor Company, by far the most promising customer, wanted to use magnesium pistons. Ford established a small foundry with the aid of Dow technicians, but the project collapsed in 1934.[28] Meanwhile, Dow pushed forward its metal production as follows: 1928, 522,099 lb.; 1929, 1,313,853; 1930, 1,160,122; 1932, 1,660,972. Dollar volume of sales, however, dropped by 50% after 1930. Dow also added to its fabricating facilities by enlarging its foundry and setting up a small rolling mill and a hydraulic extrusion press.[29] The slow pace of expansion of gross sales probably discouraged Dow from competing with Alcoa. Cheap mass production would have entailed high initial expenses for electrolytic cells and other facilities. And the difficulty of shutting down cells and later restarting them would have forced continuous production even though the market was immature. Therefore, the expense of unsold inventory was another capital risk of bold competition.

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[27] Desiring large royalties, I. G. reserved the power to force MDC to issue production and fabrication licenses to General Motors, Chrysler, Nash Motor Corp., Ford, and DuPont, but only to make magnesium for their own use. This was a protection to Alcoa. *Ibid.*

[28] I. G. Farben owned 20% of the stock of the Ford Motor Company of Germany and was represented on its board by Robert Bosch. Edsel Ford became a director of American I. G. (later General Aniline and Film).

[29] " Dow and Magnesium ", pp. 22-25.

While I. G. and Alcoa were conducting negotiations dangerous to Dow, the latter reduced the price of magnesium from 40c. to 32c. in August, 1931. This may have indicated to Alcoa, Dow's chief customer, that it did not have to produce magnesium, but could buy its alloy needs cheaply, and that Dow would take steps to keep its market position. Perhaps Dow was also bidding to be admitted into the Alig agreement—a step which Roy A. Hunt, president of Alcoa, refused to permit because of the anti-trust laws.[30]

Dow's coöperation was essential to the profits of MDC. MDC had vainly tried to make Dow and its customers pay tribute to MDC for fabricating patents, but the customers refused to pay royalties on metal supplied by Dow. Without production, MDC could not expect much income from royalties.

I. G. was therefore anxious to start magnesium production, as only customers for Alcoa-I. G. metal would be willing to pay royalties to MDC. Confident of the competitive advantages of the I. G. methods as compared with Dow's, I. G. wanted the new production company to be completely integrated, so that fabrication profits would make up for losses on the raw metal sold at prices competitive with Dow. Also a sales unit not connected with Alcoa's Sales Department would promote magnesium products more actively than Alcoa's aluminum-minded selling staff.[31]

THE INFRINGEMENT SUIT

But Alcoa firmly opposed the " wanton " expansion of MDC into magnesium production. The new investment might make

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[30] *Bone Exhibits 14, 15.*

[31] *Bone Exhibits 16, 17.*

Alcoa's aluminum facilities obsolescent.[32] With lower prices, the uses of magnesium might expand. To force Dow to pay royalties to MDC, Alcoa favored filing suit against Dow, charging infringement of the sulfur sand patents in the handling and molding of molten magnesium. A bill of complaint was filed October 27, 1932.[33] The threat bore fruit in formal negotiations between Dow and Alcoa. Alcoa's representative (Edward L. Cheyney, District Sales Manager in Cleveland) told the Dow spokesman that Dow should rely on Alcoa to develop the magnesium market, rather than expand into the fabrication business.

> Dow is essentially a chemist which merchandises its product in a known market, whereas the Aluminum Company is essentially a metallurgist which develops its markets ... if ... Dow expects to go into the business of fabricating metal, it would spend actually millions of dollars in duplicating equipment which we now own.[34]

But Alcoa did insist on retaining a " firm hold " on magnesium if Alcoa was to spend " energy and a lot of money " on promotion. Dow was willing to sell all its magnesium to Alcoa at a fixed price on a long term basis. This arrangement satisfied Alcoa's desire to prevent independent fabrication, and disposed of Dow's marketing problems.

I. G. PROTESTS

I. G. was highly displeased by such a relation between Alcoa and Dow, which merely used MDC patents as a tool to make cheap magnesium available to Alcoa. I. G. wanted to realize profits—" the financial exploitation of our experience and patents ". As AMC had the free use of MDC patents, I. G. would receive no compensation unless other fabricators developed. I. G. feared that Dow's price reductions would block I. G.'s entry into production, even if the demand increased. I. G. wished either to fight it out with Dow in the production field, which it felt well-equipped to do, or to include Dow in the I. G.-Alcoa " sphere of interests ".[35] Although I. G. favored independent fabrication licensed by MDC, Alcoa opposed this—it preferred to restrain the growth of the magnesium business and the dissemination of techniques, and wished to keep to itself the profits of magnesium fabrication. Alcoa had to appease I. G., however, for I. G. threatened to sell its interests in MDC, which might have meant that I. G. would enter the American magnesium business through another door.

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[32] *Bone Exhibit 27*. I. G. observed that Alcoa never felt " a direct stimulus to invest money in the magnesium production ". Alcoa at the end of 1932 was " more careful in its investments than it has ever been before and its board of directors does not authorize anything which does not guarantee certain profits ". Alcoa argued: " Why should we produce still more magnesium if the magnesium production of this country is already sufficient? "

[33] *Bone Exhibits 19, 22.*

[34] *Bone Exhibit 21-C.*

AMC REVISED

After " unbelievably strenuous efforts [of I. G.] in numerous conferences ", Alcoa agreed to accept I. G. as an equal partner in AMC, and held out the promise of future magnesium production.[36] The I. G. interest in AMC was held by I. G.'s agency in the United States, the American I. G. Chemical Corporation, organized 1929. Later the name was changed to General Aniline and Film Corporation.[37] The agreement, dated February 8, 1933, was to run for at least 18 years, and required AMC to pay MDC a license fee of 1c. per lb. of magnesium produced. MDC was to help AMC set up a magnesium producing and fabricating plant, and was to license AMC under all patents. AMC was to become the producing company contemplated in the original Alig agreement. The new agreement stipulated price and quantity maxima to be observed in AMC's pending purchase contract with Dow. Alcoa, by including I. G. in AMC's profits from magnesium fabrication, and by tempting I. G. with a never-fulfilled hope of magnesium production, prevented I. G. from dissolving MDC and starting an independent magnesium enterprise. The agreement also protected Alcoa against competing fabrication enterprises.[38]

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[35] *Bone Exhibit 23.*

[36] *Bone Exhibit 24.*

[37] Indictment No. 109-191, p. 5; Indictment No. 109-190 (Criminal), In the District Court of the United States for the Southern District of New York, United States of America v. American Magnesium Corporation, et al., Returned January 30, 1941, p. 3.

When AMC, representing Alcoa and I. G., completed the 1933 purchase contract with Dow, it received magnesium at preferential prices. By the terms of the Purchase Agreement dated June 24, 1933, Dow undertook to fill all AMC's possible magnesium needs for 5 years, and AMC pledged to maintain its current rate of purchase.[39] AMC could increase the amount at will. The base price was 4c. lower than Dow's current price of 28c. But as Dow's sales (exclusive of those to Ford) expanded, the base price was to be progressively lowered.[40] Receiving these price reductions from Dow, AMC would not manufacture any of its increased requirements itself. The base price was for commercial cast ingot; AMC could buy alloys at the appropriate base price (according to the schedule based on Dow's total sales) plus the "fair cost" of alloying plus 10% profit. But the alloy price paid by AMC was not to exceed that charged by Dow to its own fabricating department. In other words, Dow was to have no cost advantages over AMC in the fabrication of magnesium, and could not undersell AMC by virtue of lower metal costs.

THE FAIR COST FORMULA

This arrangement contrasted sharply with Alcoa's customary procedure applied in its integrated production of aluminum. Alcoa's fabrication subsidiaries were able to undersell independent aluminum fabricators, because in selling ingot to rolling mills and casting foundries Alcoa charged them higher prices (before 1933) than it charged its own mills and foundries.[41] As Dow reduced its cost of magnesium production through larger production and improved methods, AMC was to share fully in the advantages and expected to hold its relative share in an expanding market for magnesium products by means of the preferential prices.[42]

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[38] Paragraph 9, *Bone Exhibit 25*: "Alcoa and I. G. agree that they will not start or undertake any fabrication of magnesium in the United States of America and its dependencies outside of AMC except on request of AMC."

[39] *Bone Exhibit 27.*

[40] *Bone Exhibit 26.*

In selling fabricated goods, Dow was required to compute sales prices on the basis of a special formula—a base price for the metal plus the " fair cost " of alloying and fabrication and a stipulated gross profit. These " fair costs " were not related to actual costs.[43] So Dow's costs were put on the same basis as AMC's. AMC was also allowed to buy magnesium at the " lowest net price " at which Dow sold to other customers—probably more as a check on price-cutting by Dow than as a means of securing preference. Wrote W. G. Harvey of the Alcoa Cleveland Works to I. W. Wilson, vice-president of Alcoa (on December 31, 1932):

> We do need and through this instrument should obtain some protection against low-priced sales of sand and die castings, extrusions and rolled sheet in which low metal values are used.[44]

How important it was for price policy to control fabrication costs as well as metal costs is made clear by the fact that the metal cost of sand castings, the most common fabricated magnesium product, was only ten percent of the total cost.[45]

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[41] Equity No. 85-73, Brief for the United States, pp. 495-624.

[42] *Bone Exhibit 26.*

[43] Indictment No. 109-190, p. 13.

[44] *Bone Exhibit 31.*

[45] When the purchase contract was renewed in 1938, the base price was reduced 3c. (and so was the entire price schedule). AMC minimum purchases were raised to 4,000,000 lb., and the sales to Ford were no longer exempted from the calculation of Dow's total sales for the purpose of setting prices payable by AMC.

Dow's low prices to AMC convinced I. G. that it was futile to start independent production even in a pilot plant, as I. G.'s cost superiority was no longer demonstrable.

THE CROSS-LICENSING AGREEMENT

Some months after this contract, the stabilization of the magnesium market was completed by a cross-licensing agreement among Dow, AMC and MDC, dated January 1, 1934. MDC withdrew its pending patent suit against Dow. MDC granted Dow a license, with the right to sublicense, under MDC fabrication patents, and Dow granted AMC similar rights under its fabrication patents. Each agreed that sublicenses would require royalties of 1½c. a lb. unless the patented processes were used on magnesium bought from Dow or AMC. These patents " comprised the great bulk of patents relating to the fabricating of magnesium products in the United States and largely dominated such fabrication." [46]

Dow and AMC were to notify each other on the granting of a sublicense, and neither would attempt to license the sublicensee of the other under the same patent. This would imply that neither would go after the other's customer. Dow pledged to pay MDC and AMC royalties on all magnesium sold in any form except exports or metal losing its identity as magnesium in the initial use (other than magnesium powder).[47] Dow was to pay MDC ⅔ of royalties received from Dow's sublicensees, and AMC was to pay Dow ⅓ of any royalties received from AMC sublicensees.

AMC's royalty commitments were light, as it bought its magnesium from Dow, which would pay royalties to MDC at the time of sale to AMC. Dow, on the contrary, had to pay a royalty on *all* its metal sales, although it had no licenses under MDC production patents and used its own production methods, and although its ingot sales did not involve use of fabrication patents either. Why, then, did Dow agree to pay royalties? It is possible that the answer lies in the charge of the Department of Justice that Dow and AMC " through many meetings have agreed to and have refrained from price competition in the sale of magnesium and in solicitation of each other's customers " and that the companies conspired effectively to restrain production and sale of magnesium, to exclude others from the trade, and to keep magnesium prices at " artificially, unreasonably high and uncompetitive levels ".[48]

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[46] Civil Action No. 18-31, In the District Court of the United States for the Southern District of New York, United States of America, Plaintiff v. Aluminum Company of America, Dow Chemical Company, American Magnesium Corporation, Magnesium Development Corporation, Defendants, Complaint filed and consent decree entered April 15, 1942, p. 6.

[47] As Dow did not use MDC production processes, MDC, in requiring this royalty on ingot, exceeded the power legally conferred by MDC patents.

PATENTS HELPED DOW CONTROL

For Dow, patents were an important tool of market control. Dow was able to force foundries to buy from it by its power to grant royalty-free fabrication licenses. Before 1934, Dow had granted an informal oral license to its customers, under its own patents and those which AMC had pooled with Dow in 1927.[49] The 1934 cross-licensing agreement required sublicenses to be in writing and tied to each purchase order by a specific termination date. The form of sublicense was based on Alcoa practice—although Alcoa denied, in the 1937 suit, that it required users of its piston patents to buy their aluminum from Alcoa.[50]

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[48] Civil Action No. 18-31, p. 10.

[49] *Bone Exhibit 37*. Some of Dow's 24 pre-war sublicensees were: the Hoover Co., Eclipse Aviation Corporation, Pyle Pattern and Manufacturing Corporation, Wright Aeronautical Corporation, Doehler Die Casting Company, Baumgardner Manufacturing Corporation, Wellman Bronze and Aluminum Company, American Foundry Equipment Company, Detroit Pattern Plate Company, Springfield Bronze and Aluminum Company, H. L. Harvill, Incorporated, Magnesium Fabricators Incorporated, and Fremont Flask Company.

[50] "Alcoa not only used its patents to force Aluminum Industries to buy metal from Alcoa, but it has refused to grant licenses to others because they would not purchase aluminum from it". Equity No. 85-73, Brief for the United States, p. 492.

The legality of this method of controlling buyers was questioned in the Leitch v. Barber case, heard before the Supreme Court in 1938. The court declared that an unpatented item might not be forced on a customer as a prerequisite to his use of a patented item. The later application of this principle in another case[51] caused some alarm in Alcoa's patent department, which felt that Dow might be attacked for requiring purchase of magnesium for use of Dow's fabrication patents. W. D. Keith, Alcoa's patent counsel, suggested that the magnesium fabrication licenses be issued free of metal purchase provisos, but for one year only (after which they could be cancelled on 90 days notice). This was done in May, 1938.[52] In this way the effect of the earlier tying clause was maintained. Apparently the fabrition patents continued to be used to control markets after 1939, in spite of Leitch v. Barber. Mr. L. B. Grant, Dow's magnesium sales manager, required the Superior Bearing Bronze Company to sign a 12-month purchase contract before Dow would issue a sand casting license for magnesium alloys.[53] The Grand Jury indictment charged that Dow has

> continually compelled each prospective sublicensee as a condition precedent to the issuance of a royalty-free sublicense, to enter into a purchase contract with Dow for its requirements of magnesium, and has not and does not issue any sublicenses on a royalty basis.[54]

The sublicense was also a weapon of joint market control by Dow and AMC. As both companies used identical forms, customers could have no real choice of purchases on the grounds of a " better license ". Dow notified AMC when it granted sublicenses. AMC granted none, but was kept aware of the identity and metal purchases of fabricators. Dow refused sublicenses to some applicants, when they seemed to threaten the market of some other established fabricator. By some private agreement Dow sold castings at prices noncompetitive with those of aluminum castings while Alcoa was on the lookout for violations.[55]

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[51] American Lecithin Co. v. Warwick Co., 23 Fed. Supp. 326.

[52] Indictment No. 109-191, p. 15.

[53] *Bone Exhibit 39.*

[54] Indictment No. 109-191, p. 15.

GAINS TO ALCOA

From the viewpoint of Alcoa, the chief gain realized from its understandings with Dow and I. G. for regulation of the magnesium market, was the slow commercial development of the magnesium industry which was attributed to these understandings by the government in 1941.[56] The closely held patent pool acted as a deterrent to outside enterprise in production and in fabrication of magnesium. This interpretation is supported by the terms of the 1942 consent decree requiring open royalty-free licensing under all magnesium fabrication patents and open royalty-free licensing under the production patents for the duration of the emergency, and cancelling all patent licenses and agreements embodying them among Alcoa, AMC, and Dow.[57] A reasonable and non-discriminatory royalty may be charged at the close of the war emergency. As the Department of Justice requested the decree to increase magnesium production for war, it is clear that the patent agreements were regarded as a restrictive force on production.

Just as important as the patent controls was Alcoa's influence on the price of magnesium. As mentioned above, magnesium, with a specific gravity ⅔ that of aluminum, achieves " volume parity " of price with aluminum when magnesium sells at 1½ times the price of aluminum. At any price under " volume parity " magnesium competes closely with aluminum in any uses to which both are applicable. (See Chapter I.) As magnesium fabrication and alloying techniques in the United States are backward, and as the newer metal is unfamiliar to many users, magnesium might have to sell well below parity to win buyers away from aluminum.

[55] *Bone Exhibits 35, 36, 28, 40.*

[56] Civil Action No. 18-13, p. 10.

[57] *Ibid.*, pp. 16-21.

Through its purchase contracts, and unwritten understandings as to price control, Alcoa kept the price of magnesium close to volume parity with aluminum and prevented it from dropping to a level which would endanger the aluminum market. The technique of this control is exemplified in the 1933 purchase contract requiring Dow to give AMC the benefit of price reductions and increased sales. Thus Dow's incentive to reduce prices was impaired. The results of this control are demonstrated in the history of aluminum and magnesium prices in the prewar decade. Not only was the magnesium list price kept at 30c. *for seven years* (1932-8), but the ratio of magnesium prices to aluminum prices averaged but slightly below 1.5/1 1931-40. Over these years, the technique of magnesium production, alloying and fabrication steadily improved, numerous patents were issued, and a ferment of experimentation continued to bubble. Changes in general business conditions and in the demand for magnesium for aviation building programs did not seriously alter this relation of aluminum and magnesium prices.[58]

WHAT I. G. REAPED

I. G. benefited from its agreements with the two American companies. Although frustrated in its wish to profit on magnesium patents or to start magnesium production, I. G. was able to keep Dow from effectively competing in the European magnesium market until 1939 by the medium of an ordinary sales contract arranged in 1934. Dow had made its first export sale of magnesium in 1928 (5,000 lb. sold to Germany), but in the next year had sold 112,000 lb. to France and England. After a lag in 1930, foreign sales rose again, and in 1933 were 439,000 lb., of which 190,000 lb. went to England and the rest to Mexico, Germany, and Russia.[59] " The price and quality of Dowmetal were getting a reputation abroad in competition with Elektron metal ". This was especially true in 1934 when the devaluation of the dollar by the United States gave foreign buyers a 40% discount on American purchases. By summer of 1934, Dow export sales made it possible to reduce inventories.

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[58] It is admitted of course that the list prices of ingot are an imperfect guide to actual received prices of all magnesium products. Most of the metal is alloyed before sale to the fabricator. Sales are concentrated in relatively few alloys out of the wide range offered; these apparently sell at a premium averaging about 3c. above the pure magnesium price. But the fabricated forms are diverse, and it is hard to compare prices of different forms, sold to different users at different times. Magnesium sales are private transactions; magnesium in primary and fabricated forms appears on no organized market. Varying specifications of the buyer complicate the task of appraising the average price of magnesium. The only continuous data are Dow's published list prices. Although a very large part of Dow's sales have been made to AMC at special contract rates, these rates have been tied to Dow's published prices.

" These foreign sales were evidently a matter of concern to the I. G." [60] I. G. contracted to buy from Dow 350 tons of magnesium at 20c. a lb. in the last half of 1934, and 600 tons in 1935, and secured an option for purchases in 1936 and 1937.[61] The price was far below the American price in 1935 and 4c. below Dow's price on other foreign orders.[62] Dow promised not to sell magnesium to other European buyers except for a limited quantity to an old customer, the British Maxium Company. But Dow would give British Maxium no preference over I. G. Dow agreed to try to prevent Maxium from reselling its purchases as ingot.

By this agreement, Dow refrained from disturbing I. G.'s control of the European market, already built up by patent controls, and kept Britain dependent on I. G. for supplies.[63] Dow's sales manager wrote from England in 1935 that Maxium was " very much in need of additional magnesium ", and that if

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[59] *Truman Report on Magnesium*, Appendix III, p. 55.

[60] " Dow and Magnesium ", pp. 28-29.

[61] *Bone Exhibit 41*, and *Bone Hearings*, part 2, p. 928.

[62] According to Dow, the price paid by Farben was 21c. c. i. f. Hamburg, while the price realized from domestic sales (excepting those to AMC) was 28.17c. a lb. " Dow and Magnesium ", p. 68.

[63] Borkin and Welsh, *op. cit.*, p. 233. British imports of magnesium from Germany exceeded domestic production in Britain until 1938.

Maxium had not secretly exported 60 tons of ingot to Europe, the company " would have had sufficient supplies this year ".

> The sales manager could not recollect the facts or interpret this memorandum for the committee. Dr. Dow however did state that he believed that any inability to furnish more magnesium was due to low inventories after the deliveries to Farben rather than to the prohibition in the contract with Farben against delivering more than 300,000 pounds to this particular British concern. An examination of the inventory records, as furnished by Dow Chemical, indicates, however, that there was some inventory out of which later sales could have been made.[64]

Dow allowed I. G. to retail Dow's magnesium in Great Britain, France and Italy and to collect " middleman's profits " on these transactions, instead of expanding its own sales directly. The pattern of market division in magnesium resembles that in aluminum. Alcoa abstained from exporting aluminum abroad in conformity with cartel agreements to which Alcoa was directly or indirectly linked. Dow allowed I. G. to preëmpt 50-60% of its magnesium output.[65] Alcoa, I. G.'s partner in MDC and AMC, may have favored this export contract as a way of diverting magnesium from the American metals market. The retardation of the American industry was a boon to I. G. Farben's European control. In other words, small American production automatically limited exports from America.

CONTROL OF AMERICAN OUTPUT

That I. G. may have considered this even when it was advocating an Alcoa-I. G. magnesium production company, is shown by the limitation in the Alig agreement. Under that agreement, the " initial contemplated production capacity " of the planned venture was limited to 4,000 tons and I. G. was permitted to delimit any increases proposed beyond the initial capacity. The fact that Dow's production was only 2,400 tons in 1938, and well below that figure in preceding years, has been cited as evidence that I. G.'s "veto power", originally planned to cover Alcoa-I. G. production, was extended over Dow when Dow was brought into the Alcoa-I. G. sphere of interests. But it could also reflect absence of interest in magnesium on the part of our military authorities, or Dow's failure to build a civilian market. I. G. probably wished to prevent so large an American production that I. G.'s European market control would be jeopardized, and to hold back American war preparations. However, I. G. wanted to make profits on its technology through royalties based on bigger production, and so had conflicting interests. The blocking of American war preparations may have become an important motive after 1934, when Hitler sped the construction of the Luftwaffe with a new building program calling for expanded aluminum and magnesium production. It could not reasonably have been the only motive, for magnesium was a less vital war industry to the United States, relatively well-equipped for aluminum production, than it was to bauxite-hungry Germany.

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[64] " Dow and Magnesium ", pp. 68-69.

[65] *Bone Hearings*, part 2, p. 982. I. G.'s purchases were equal to 50% of Dow's 1934 capacity, and were more than Dow's annual domestic sales.

However the role of I. G. is evaluated, all available evidence suggests that Dow's limited production illustrates equally well Alcoa's whiphand. Alcoa reserved the right to increase its magnesium purchases from Dow at will—useful in case Dow set its cap for new markets among aluminum users. AMC shared fully in any price reductions Dow might undertake, thus preventing Dow from making discriminatory price cuts to win new business from outside customers. AMC dominated Dow's price policy in regard to fabricated goods as well as ingot. Magnesium could not hope for new markets until it sold below volume parity with aluminum, and the possibility of a retaliatory reduction in aluminum prices may have added another restraint to those already in force.

EXPLAINING DOW'S ROLE

Dow's compliance with the limitations imposed by Alcoa and I. G. presents some problems of explanation. Risk avoidance probably dominated Dow's attitude. It could pursue a profitable price policy in a stable, monopolistic market, protected from competition of new enterprise by the MDC patent cluster. It had a steady market in Alcoa, which used magnesium as an alloying ingredient. Also I. G. may have agreed to respect Dow's chemicals market as a reward for a " go slow " policy in magnesium.

There is limited evidence available to verify such a guess. Dow was indicted in 1944 along with American producers organized in a trade association, I. G., Imperial Chemicals, Ltd., and Belgian Solvay Cie., for control of the world alkali market. (See above p. 160.)

Previous commercial relations of Dow with European producers were also revealing. Before World War I, Dow was unable to undersell the market in bromine because American pharmaceutical houses, which imported refined bromine salts from Germany, feared to " jeopardize their German connections ", and were unwilling to manufacture the refined salts from Dow's bromine. Dow determined to make and sell the refined bromine salts, and proceeded to make contracts in the United States and Japan. Thereupon Herr Jacobsen, envoy of the German bromine cartel, appeared in the United States, and threatened to send to the United States two pounds of bromides for every pound exported by Dow. When Dow refused to stop selling bromides, the German price quotation in the United States dropped 50%. Dow retaliated by underselling the cartel in Germany. For two years the battle raged; the Germans finally agreed to stay out of the United States if Dow would stay out of Germany.[66]

A similar incident occurred in the case of bleach, as German and British interests together tried to force Dow to cease "usurping" the American market. Dow successfully engaged in a price war with them which brought the price down 50% between 1902 and 1904. (Bleach is "water-slacked lime exposed to chlorine", the chlorine being a waste-product of Dow's early bromine production.)[67]

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[66] William Haynes, *Chemical Pioneers, The Founders of the American Chemical Industry*, New York, 1939, pp. 273-74.

THE COMBINATION ATTACKED

The compilation of price figures of aluminum and magnesium for the use of the Temporary National Economic Committee led to a recognition that during the 1930's the schedule prices of these metals stood in nearly a 1/1.5 ratio. (The mean ratio 1931-40 was 1/1.467 and the median 1/1.46). The price of magnesium did not dip until 1939 below the margin theoretically protecting aluminum against competition. (See discussion above, pp. 184-5.) An investigation followed, as a result ot which a Grand Jury began sitting in July, 1940, and on January 30, 1941, returned indictments against Dow, Alcoa, AMC, I. G. Farben, MDC, General Aniline and Film and nine individual officers and directors of these corporations. One indictment concerned a combination of Dow and AMC to charge uniform and non-competitive prices for magnesium, and to fix prices of all magnesium products, in particular to confine Dow's pricing policy to the "fair cost" formula agreed on with AMC. The other indictment concerned the cross-licensing agreements among Dow, AMC, and MDC, holding it an abuse of the patent privilege to monopolize magnesium production and to augment profits on the sale of an unpatented article. A press release by the Department of Justice at this time (January 30, 1941) attributed to the alleged conspiracy the following results: 1) inadequate facilities for production of magnesium for national defense, 2) restriction and discouragement of development and use of magnesium in airplane manufacture, 3) a serious shortage of magnesium foundries essential for defense, 4) an artificial and unreasonably high domestic price of magnesium, while foreign sales of magnesium by Dow were at lower prices, 5) the maintenance of a magnesium monopoly in the United States.

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[67] "Dow and Magnesium", pp. 2-3.

Meanwhile, during 1941, Basic Magnesium laid plans to produce magnesium in Nevada, using magnesite as a source of magnesium chloride, which was then treated electrolytically according to I. G. patents. On August 6, 1941, Basic's attorney approached Mr. H. M. J. Joslin, secretary of MDC, and a member of the law firm of Hutz & Joslin which figured in many agreements between I. G. and American firms, and requested licenses. Joslin temporized. Basic finally offered a small royalty on all magnesium produced in the DPC plants in exchange for a non-exclusive license, but MDC wanted more money. Negotiations went on until finally, after mutual declaration of war by Germany and the United States, Joslin resigned from MDC and I. G.'s stock interest in this company was seized by the Alien Property Custodian.[68]

On April 15, 1942, the Department of Justice filed a civil complaint, and secured a consent decree signed by defendants Dow, AMC, Alcoa, and MDC. (For citation of the decree see above p. 181.) The complaint recapitulated all the charges formerly made, and entered a prayer that the conspiracies, agreements and practices of the defendants be declared in violation of the Sherman Act, that the defendants license any applicants to make, use, and sell magnesium and its products under all their patents, and that pooling of patents in MDC be enjoined.[69]

The judgment of the court included the following points: All patent agreements and licenses among the various defendants since 1927 were cancelled. Each defendant was to grant to any applicant a non-exclusive right to manufacture and sell in the United States under all fabrication patents. No royalty was to be paid unless the applicant refused to cross-license the defendant. Under production patents similar non-exclusive licenses were to be granted, royalty-free until six months after the end of hostilities (unless cross-licensing were refused). After the emergency, the applicant might continue to get a non-exclusive license on payment of a " reasonable and non-discriminatory royalty ". Transfer of Alcoa or AMC licenses to MDC was forbidden. No agreement between any defendant and I. G. was allowed unless a copy of the agreement was filed with the Department of Justice. No quantity purchase of magnesium at a discount between Alcoa or AMC and Dow was permitted without notification of the Department of Justice, which might petition the court to declare such purchase agreements invalid. Any refusal, or conspiracy to refuse, to sell magnesium or its products, if it showed the intent to monopolize, would be sufficient grounds for the United States to request an injunction restraining such an act.[70]

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[68] *Truman Hearings*, Part 13, p. 5683.

[69] Civil Action No. 18-31, p. 11.

The defendants paid the maximum fines under the law, an act which was taken by some as evidence of guilt although the signing of the consent decree did not legally entail admission of guilt. The amount of the fine may not be great enough to place sufficient hazards upon the possible repetition of restrictive practices. Of far greater importance were the compulsory licensing of patents and the dissolution of the patent agreements. An unfortunate omission was prohibition of agreements based on future patents affecting magnesium. The Department of Justice suggested also, as a general principle, cancellation of patents illegally used to build market control, and compulsory notification of the Government when any suit charging patent infringement is filed.[71]

All the acts dissolving magnesium patent agreements and requiring open licensing would have been of little use in freeing the industry for competitive growth in the absence of an intense war demand for magnesium. The new demand protected newcomers against many risks of market development which they would otherwise have faced, and against violent retaliation by Dow in pricing magnesium and by Alcoa in pricing aluminum. Even so, certain factors in the war economy prevented the employment of a wide array of independent producers. Important new firms in war production used new processes not subject to Dow patents after the war. This would indicate a desire to escape from royalties and fear of restrictions after the war. It would also confirm the fact that protection against market risks was as important as immunity from patent litigation in encouraging entry into the industry—a testimonial to the reputed belligerency of Dow and Alcoa.

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[70] *Ibid.*, pp. 13-24.

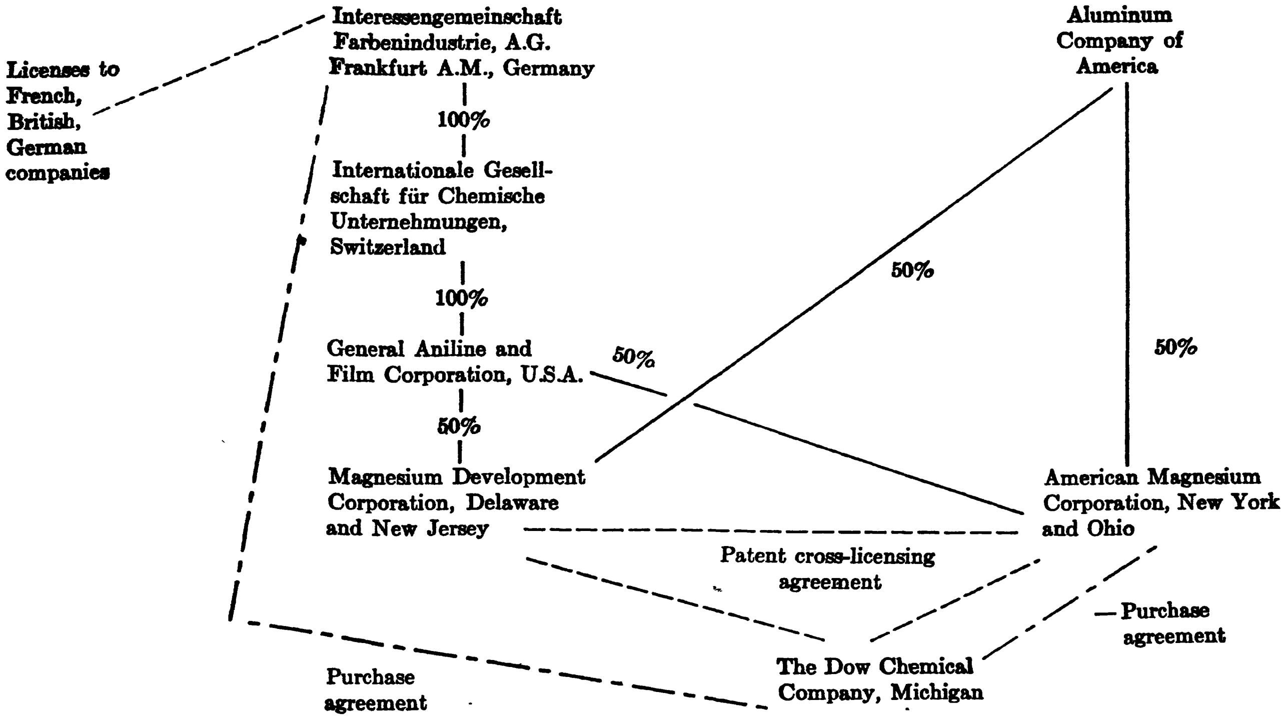
[71] *Bone Hearings*, Part 2, pp. 939, 947, 956.

If a formal cartel of legally independent enterprises is set up after the war or if tacit price observance and market division are practiced, buyers will be little better off than if pure monopoly existed. Settling of patent rights is important here, as sublicenses have been useful to monopoly in both magnesium and aluminum. The competition of new methods may enable the magnesium industry to avoid the controls implied in cross-licensing agreements; but this would not necessarily follow if the array of available methods reduces to one or two variations on the electrolytic and thermic processes, and if producers wish to use their patent strength as a tool of market control.

Government action to control royalty payments and to keep them from barring outside enterprise (rather than serving the intended purpose of promoting invention) can influence the degree of competition. The 17-year limit on patents is less effective a guarantee of eventual competition than might be thought. The complex arts of controlling magnesium fires by use of fluxes, casting and heat-treating magnesium alloys under standardized conditions, etc. permit a flow of improvement patents and complementary patents that far extend the duration of the monopoly conferred by the original patent grant.

ORGANIZATION OF THE AMERICAN MAGNESIUM INDUSTRY — 1940

(Patents, Stock Ownership, Purchase Agreements)


Licenses to French, British, German companies
Interessengemeinschaft Farbenindustrie, A.G. Frankfurt A.M., Germany
100%
Internationale Gesellschaft für Chemische Unternehmungen, Switzerland
100%
General Aniline and Film Corporation, U.S.A.
50%
Magnesium Development Corporation, Delaware and New Jersey
50%
Aluminum Company of America
50%
50%
American Magnesium Corporation, New York and Ohio
Patent cross-licensing agreement
— Purchase agreement
The Dow Chemical Company, Michigan
Purchase agreement

ANNUAL AVERAGE LIST PRICES PER POUND OF ALUMINUM AND OF MAGNESIUM METAL AND THEIR RATIOS, 1923-40

Year	(1) Aluminum	(2) Magnesium	Ratio of (2) to (1)
1923	$ .26	$ 1.25	4.80
1924	.27	.88	3.26
1925	.28	.81	2.89
1926	.275	.75	2.73
1927	.26	.77	2.96
1928	.243	.80	3.29
1929	.243	.80	3.29
1930	.238	.66	2.77
1931	.233	.42	1.80
1932	.233	.30	1.29
1933	.233	.30	1.29
1934	.22	.30	1.36
1935	.195	.30	1.54
1936	.19	.30	1.58
1937	.198	.30	1.52
1938	.20	.30	1.50
1939	.20	.275	1.37
1940	.19	.27	1.42

Average Price Ratio, 1931–40: 1 – 1.467; Median 1 – 1.46

SOURCE: Computed from records of Dow Chemical Company, and from tabulation of schedule prices compiled by Aluminum Company of America.

CHAPTER IX

COMMAND PERFORMANCE: LIGHT METALS IN THE WAR

THE second World War brought important influences to bear on the monopolistic position of the Aluminum Company of America (Alcoa), although opposing tendencies worked to check the influences inherent in the war situation. In this chapter we shall examine the interplay of the conflicting tendencies affecting monopoly power during the war mobilization, and even in the beginning of demobilization.

CURBING MONOPOLY TENDENCIES

When the national government, representing the needs of the nation as a whole, places its orders with a monopolistic war industry, the "normal" tendencies of the monopoly situation are substantially curbed. Large government orders, with financial provisions protecting business men against the risk of not realizing their costs on the market, stimulate production to the point of capacity operations. As the monopolist's production expands to full capacity, greater efficiency in operations may even encourage him to refrain from raising prices in spite of increased costs of factors of production inelastic in supply, although a substantial fall in prices would not be typical.

Alcoa had felt the influence of expanding armament programs as early as 1938, when, working at capacity, the company laid plans for large increases in capacity. Prices, far from being increased, were successively reduced from 20 cents to 15 cents, the last step being taken in September, 1941.

There were special reasons for this reduction in prices. During the period following 1937, Alcoa had been defending itself in an anti-trust trial record-breaking in length, which did not terminate in a decision in the District Court until October, 1941.[1] From the standpoint of public relations, therefore, price reductions rather than increases were appropriate, especially since evidence at the trial had suggested that Alcoa's cost of producing ingot hovered near 10 cents a pound.[2]

Secondly, certain major capital costs necessary for the provision of a power supply, an indispensable and costly element in aluminum production, were borne by the government through its federal power program.[3] Thirdly, special tax allowances permitting the cost of privately constructed facilities in war industries to be written off in only five years were voted by Congress in August, 1940. The allowances applied to plant built after July 10, 1940, and left a larger share of corporate income temporarily free from tax. Finally, as will be described, the first independent producer to make and sell aluminum in the United States since the days of the Cowles Company made its debut: the Reynolds Metals Company. The Alcoa price reduction may have served warning on potential competitors that their untried business skill, foreboding higher initial costs, would have to meet Alcoa's lower charges. If attracted by the expanding war market, they could not enjoy the umbrella of Alcoa's previous high-price policy.

As total war calls for massive increases in basic material supplies, expansion of capacity beyond the pre-war point may be demanded and even financed by the government, particularly if a new good is demonstrating its qualities for the first time on a large scale and gaining in permanent popularity. These tendencies affected aluminum chiefly through the broader use of air power in military and naval strategy, although the metal found certain other military uses in replacing scarce metals such as copper, or heavier metals such as steel. The Army found aluminum foil desirable in food packing, and aluminum invasion landing mats replaced steel, to cite two out of many uses.[4]

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[1] Equity No. 85-73, In the District Court of the United States for the Southern District of New York, United States of America v. Aluminum Company of America, et al. Petition filed April 23, 1937.

[2] Equity No. 85-73, Exhibit 718. The figure includes raw materials, labor, transportation, repairs and maintenance, depreciation, plant administration, and general overhead. Profits of direct subsidiaries, and several miscellaneous offsets, are deducted.

[3] See *infra*, pp. 219-21.

If all new capacity called for is directly controlled by the monopoly, or if the capacity, although financed and owned by the government, is integrated into the monopoly's production flow, the result of capacity extension may be merely to transform a little monopolist into a big one. Even if this occurs, the increased production and capacity imply that a larger social demand is satisfied than would ordinarily be true under monopoly policy in " normal " times.

CAPACITY AND PRODUCTION INCREASES

While the production rate of primary aluminum at the beginning of 1939 was 300,000,000 pounds a year, and had increased to only 325,000,000 pounds by the outbreak of the war, production in 1942 was 1,042,000,000 pounds, and in 1943, 1,839,800,000 pounds. The monthly rate rose from 64,500,000 pounds in January, 1942 to a peak of 188,100,000 in October, 1943, after which it declined gradually as a result of cutbacks to 152,900,000 pounds in May, 1944.[5] The bulk of the increase was produced by the eight new ingot plants which came into operation during 1942 with a total rated capacity of over 1,000,000,000 pounds. The 1943 production alone is more than double the production rate of 917,200,000 pounds a year which was attained shortly before Pearl Harbor.[6]

Capacity increases at first were confined to the privately financed efforts of Alcoa, which in 1938 inaugurated a plant expansion program finally reaching $250,000,000 and doubling Alcoa's owned capacity before the end of 1943. Alcoa set up a new reduction plant at Vancouver, Washington, using Bonneville power, and enlarged its manufacturing plants at Cleveland, Alcoa (Tennessee), Massena (New York), Lafayette (Indiana), and New Kensington (Pennsylvania). In Surinaam a new bauxite development was begun, and mining operations were extended in Arkansas and wherever even inferior bauxite was available elsewhere in the United States. A foundry and forge plant were completed in Los Angeles; testing equipment in the Aluminum Research Laboratories was expanded. Alumina output at Mobile was tripled. Alcoa went ahead with plans to develop the Glenville and Nantahala power projects on tributaries of the Little Tennessee River. Representing an investment of $15,000,000, these power projects had a planned capacity of 60,000 kilowatts—enough to serve two potrooms pouring forth 60,000,000 pounds of aluminum a year. At Alcoa, Tennessee, a new rolling mill was erected which, with a capacity of 684,000,000 pounds a year, was reckoned the largest aluminum sheet mill in the world.

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[4] *New York Times*, February 8, 1944.

[5] War Production Board, *Facts for Industry*, Series 1-2-1, 1-2-2, 1-6-4; and U. S. Senate, 77th Congress, 1st Session, *Hearings before a Special Committee Investigating the National Defense Program, Pursuant to S. Res. 71*, part 3, May 12, 14, 15, June 16, 17, 1941, *Aluminum* (hereafter referred to as *Truman Hearings*), pp. 783, 824.

[6] War Production Board, *War Production in 1942*, p. 8.

Forging capacity was increased twenty-four times, extrusion capacity eight times, castings eleven times. Alcoa's employment was doubled; in four years after December 31, 1938, its total assets had almost doubled. Capacity extensions were spaced as follows: 150,000,000 pounds between September, 1939 and December, 1940, 180,000,000 pounds in 1941, 55,000,000 pounds in the first half of 1942, raising total capacity to 730,000,000 pounds by August, 1942. Later additions brought Alcoa's owned capacity up to the grand total of 848,000,000 pounds as reported in January, 1944.[7]

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[7] *Moody's Manual*, 1943, p. 383; *Truman Hearings*, part 3, pp. 783-84, 793, 797, 900-1; Aluminum Company of America, *Annual Report*, for 1939, 1940, 1941; *New York Herald Tribune*, January 3, 1943; 77th Congress, 1st Session, *Sen. Rep.* No. 480 (Truman Committee), *Report of Mr. Mead*, June 26, 1941, p. 7.

NEW FIRMS AND PROCESSES

When wartime expansion calls for a government investment in plant capacity, the government may be able to introduce new firms to supply the new capacity, thus deliberately destroying the monopoly, at least while the capacity is in use. In wartime the granting of a subsidy to a new entrepreneur would be the more weakly opposed, as it would be related to military need. In production of light metals such subsidies would take the form of government investment in production plant and in power developments. However, the use of a war emergency by government to destroy monopoly is limited by the necessity for getting production as rapidly as possible. There is undoubtedly some merit in the argument that under the pressure of war needs the government cannot afford to experiment with entirely inexperienced operators and new enterprises. Those already skilled in a particular kind of production must be relied on rather heavily.

The magnitude of government subsidy for wartime aluminum production is indicated by the total commitments of the Defense Plants Corporation (DPC): $779,465,000, of which $185,799,000 went to aluminum smelters, $83,398,000 to alumina plants, $441,429,000 to fabrication plants, $28,204,000 to power facilities for aluminum production, and the remainder, $35,635,000, to miscellaneous projects related to aluminum.

Independent firms, however, received scanty pickings. In December, 1943, all the alumina plants built and operated for the DPC were in the hands of Alcoa as manager. A DPC plant managed by Kalunite, Inc., was then on the verge of production. All but one of the aluminum reduction plants of the DPC were in the hands of Alcoa, which turned out 96 per cent of the output of DPC aluminum plants. The Olin Corporation plant in Tacoma, Washington, affiliated with Kalunite, was the sole, small exception. Alcoa also took a large share of the DPC fabricating plants, having been designated " to build and operate numerous government-owned fabricating plants." [8] How this concentration of control over DPC capacity came about is the subject of inquiry below.

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[8] *Moody's Manual,* 1943, p. 383.

As a higher rate of production is demanded, new processes may be introduced, either through the medium of new firms or through the old monopoly. Sometimes new processes have been withheld because they afford a greater volume of production than the peacetime market will absorb without major price changes or an aggressive educational campaign. Sometimes independent entrepreneurs have been unable to market or develop their new processes because a monopoly controls a limited market. In either case, guaranteed market expansion allows new techniques to build a beach head. But a beach head is not enough. In the case of aluminum, where outsiders were the bold bearers of new methods, they were blocked by policies which emphasized speed of war production and in so doing protected Alcoa's position: This was in large part the result of the fact that the many new processes were necessarily experimental no matter how promising the laboratory tests may have been. Had the monopoly situation been corrected before the war, it would not have been necessary to choose between granting orders to a monopoly and dealing with novices.

War creates an atmosphere in which " consumer " is identified with " the nation " with striking symbolic results. Attention is turned to the social performance of war industry. Poor performance—in quality control, meeting volume needs, control of costs—is immediately seen as detrimental to the public interest. Aluminum production has been subjected to public scrutiny through the efforts of journalists like Drew Pearson of the *Washington Post* and I. F. Stone of *PM* and *The Nation,* and through the hearings and reports of the more august but equally piercing Truman Committee of the Senate, later under the chairmanship of Senator James Mead of New York. Private business and war agencies acting in collusion have felt the sting of the Truman Committee's criticism. Disapproval falls heavily on profiteering and monopoly restrictions. Nevertheless, not all factors in a war situation are conducive to greater flexibility and social responsiveness of monopolies, and to the entry of new firms. Administrative officials in charge of procurement, government investment, and related matters may be drawn from the ranks of big business, if not from the very industry with which they must deal. They may reflect a point of view which is unsympathetic to small business. High officials may be free from these traits but forced to rely on the practical advice and technical knowledge of subordinates or consultants, trained in the ranks of big business.

THE SHARE OF THE MILITARY

Some share of the responsibility for the well-known delays in aluminum procurement to meet United States war needs falls on the Army and Navy Munitions Board which took aluminum off the strategic list in January, 1940. In April, 1940, the Board was quoted as " anticipating no major problem " in the aluminum industry. While it was conceded that civilian and military requirements, especially in aircraft and heavy transportation, were increasing at an accelerating rate, and that fabricating facilities and bauxite might be inadequate if the demand for special shapes increased, the Board listed aluminum as " critical ", not " strategic ". The critical category embraced materials essential to defense, but less essential than strategic materials, more available at home, and requiring " some conservation and distribution control ". The Board concluded cheerfully: " After several years of research, and continued technical developments in that industry, a thorough survey of materials and facilities matched against requirements reveals that no particular problem is presented." [9]

Discouraging a self-sufficiency policy toward bauxite as too taxing a drain on our limited home supply of bauxite, the Army favored, as an emergency measure, maintaining the sea lanes to

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[9] Army and Navy Munitions Board, *The Strategic and Critical Materials*, March, 1940, pp. 20-23; *Strategic and Critical Raw Materials*, Department of Economics, Government and History (West Point, 1940), p. 15.

South America until home resources were made available! Thus our military authorities made several mistakes in planning: (1) they greatly underestimated the aluminum requirements of a protracted air war; (2) assuming that no interruption of shipping was within the horizon of probability, they ignored the possibility of building up a stockpile of aluminum; (3) they made no plans for developing new methods to utilize home resources. It is of interest that the relations between the Army and Alcoa had been reputedly cordial and intimate for many years before the war. A considerable amount of joint research had taken place.

In June, 1940, estimated requirements for May, 1941, were fixed at 50,000,000 pounds a month, of which only half was military. With current production capacity of Alcoa then at 30,000,000 pounds a month, no great procurement problem was foreseen. But when President Roosevelt, in May, 1941, announced the production objective of 500 bombers a month (each bomber absorbing from 60,000 to 80,000 pounds of aluminum), the direct military program was raised to 100,000,000 pounds a month.[10] This meant not only using all current production for the most urgent military needs, leaving none for civilian uses, but also great production increases for military use alone—an aim finally attained as the aluminum production program reached its peak nearly two years after Pearl Harbor.

RELIANCE ON ALCOA

Until August, 1941, there was no contract signed for government-financed expansion of aluminum capacity; Alcoa privately financed the enlargements and additions which were to yield capacity for approximately 700,000,000 pounds (or about half the military program as foreseen in the spring of 1941) by the end of 1941.

Yet there was assurance on the part of public officials and Alcoa that production plans were completely geared to war needs. It would appear that the inexperience of some government planners forced them to rely heavily on the program and interpretation of the established firm. It would hardly be surprising if, in such a case, planned capacity were restricted for fear of post-war surpluses. Starting in May, 1940, Edward Stettinius, then a member of the National Defense Advisory Commission and later of OPM, assured the public that aluminum was not scarce. He reiterated, on November 8, 1940, that there was an actual surplus of aluminum over military and civilian needs. A few weeks later, Northrop Aircraft, Inc., made the nation's headlines by complaining of insufficient aluminum supplies for airplane production.[11]

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[10] *Truman Hearings*, part 3, pp. 713-15.

On August 12, 1940, Irving W. Wilson, Vice-President of Alcoa in charge of operations, and one of the last witnesses in the anti-trust trial, testified that Alcoa was in a position to supply the United States government with all the aluminum needed for military expansion in the coming year, and to provide additional amounts for the British. Wilson further assured the court that Alcoa's private expansion programs would be enough to supply the United States government for two years, even should requirements continue to increase. According to I. F. Stone, Richard S. Reynolds, President of the Reynolds Metals Company, fearing German air strength augmented by bauxite and aluminum from conquered France, urged Arthur V. Davis to ask the government for funds to triple Alcoa capacity, with the agreement that new plants be closed down at the end of the war. Davis told Reynolds there was ample aluminum and no cause for unnecessary alarm.[12]

But William Batt, Deputy Director of Production in OPM, was forced to tell the Truman Committee on May 12, 1941, that " our sights all the way down the line have been too low " and that 1941 production would meet only the highest-priority military requirements, mainly the heavy bomber program.[13]

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[11] I. F. Stone, *Business as Usual, The First Year of Defense* (New York, 1941), p. 54.

[12] *Ibid.*, p. 51.

[13] *Truman Hearings*, part 3, p. 716.

Two days later G. R. Gibbons, Senior Vice-President of Alcoa, asserted before the committee: " There is plenty of aluminum for national defense today, at this minute . . . There may be a shortage next month." [14] Secretary of the Interior Harold L. Ickes retorted a month later: " That is a statement which was as incorrect then as it is incorrect to date. Personally I think that this statement betrays either incompetence or self-interest, both of which are dangerous to our program of national defense." He complained that, unless the government built aluminum plants, " we would continue to be at the mercy of the Aluminum Company's apparent purpose to continue expansion on a piecemeal basis."

OPM AND THE SHORTAGE

Senator James Mead's summation of the state of affairs in a special report issued by the Truman Committee lays the blame of " serious miscalculations " on OPM for relying upon Alcoa's assurance as to the adequacy of the supply.

> During this time . . . OPM had apparently completely relied on . . . Alcoa as a source of information as to the availability of aluminum and had discharged [*sic*] anyone else from going into the business. . . . It is reasonable to conclude that Alcoa had convinced . . . OPM of the adequacy of the supply in order to avoid the possibility that anyone else would go into a field which they had for so many years successfully monopolized. How they expected to take care of the situation when the shortage became apparent is not clear. They may have reasoned that in its desperation the Government would do almost anything to increase the supply and that Alcoa would be favorably treated by the Government in order to assure an adequate supply for defense purposes.[15]

The OPM itself blamed the shortages on several factors: (1) increased working inventories of aircraft plants which stocked up for ten months of production instead of for the expected two months, (2) increased indirect military requirements such as wire, pots and pans, (3) large withdrawals of secondary aluminum from the market, (4) a temporary fall in imports from Canada, and (5) bottlenecks in finishing capacity.

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[14] *Ibid.*, p. 817.

[15] *Mead Report*, p. 3.

The increased inventories and the withdrawal of secondary aluminum can be interpreted as hoarding induced by an uncontrolled market and by uncertainty that supplies would be forthcoming when needed. This reflects the inadequate scope and intensity of control and its slow application in a particularly tight market.[16] The lack of fabrication facilities suggests inadequate coördination of expansion by Alcoa, as well as chronic limitations of capacity.

Meanwhile, Reynolds Metals Company, without encouragement from the National Defense Advisory Commission or its successor, OPM, proceeded to construct plants of 120,000,000 pounds capacity in 1940, financed by an RFC loan. Senior Vice-President Gibbons of Alcoa said in 1941: "I did think last fall [1940] that there was a high probability of their being very much less need for aluminum than turned out to be the case. That was my error, but I recall distinctly thinking we were forging ahead, and where were we going to land out here? . . . I didn't know, but I thought we might land with a huge capacity here and nowhere to go." [18]

THE GOVERNMENT EXPERT

Grenville R. Holden, OPM consultant on aluminum and magnesium, told the Truman Committee: "I think . . . Alcoa as the only producer of aluminum is the only place where we are sure that we can get aluminum." [19] But he failed to

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16 *Truman Hearings*, part 3, p. 714. As late as February 21, 1941, the *New York Herald Tribune* spoke of a voluntary attempt of aluminum-using industries to distribute the supply equitably. Shortly after, the OPM restricted the flow of aluminum into ice trays (*New York Times*, March 9, 1941), and on April 6, 1941, the *New York Herald Tribune* reported that OPM *intended* to cut down on the consumption of a small quantity of aluminum in private airplanes.

18 *Truman Hearings*, part 3, pp. 820-21.

19 *Ibid.*, p. 848.

study Reynolds' facilities before deciding to confine the government's expansion program to Alcoa. He was even prepared to recommend a proposal of Alcoa's counsel, Oscar Ewing, that the War Department buy the Fontana dam site from Alcoa. The plant had been kept idle to avoid recapture under the terms of a Federal Power Commission license.[20] Ewing had proposed that the War Department build the dam and power facilities, and lease them to Alcoa for five years with the lessee having option to buy. If it had been adopted, the proposal would have reversed the long-run power policies of the federal government.

"I was prepared to recommend anything that would get aluminum", stated Holden, when questioned on his attitude towards Alcoa.[21]

The very existence of the monopoly implies that new firms must be young,, inexperienced (owing to the shortage of technicians), full of experimental methods.[22] Initial failures, for example, in developing a new method, reinforce the conviction of conservative officials that it is unwise to deal with young fry.

PRODUCTION FROM CLAY

The challenge of new enterprise and methods was offered in the field of alumina production from non-bauxite clays. Only one out of sixty processes submitted to the War Production Board had reached the point of production by December, 1943, and it seemed unlikely that the chief runners-up would be as successful. "Many of the substitute processes were technically defective; some were poorly presented or insufficiently researched; but about a dozen withstood close technical review.

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[20] See *infra*, pp. 74-6.

[21] *Truman Hearings*, part 3, p. 844.

[22] As late as June 1941, I. W. Wilson of Alcoa admitted that the company had no apprentice program to increase the supply of competent plant officials. *Truman Hearings*, part 7, p. 2116.

Only one—Kalunite, Inc.—has broken out into the clear."[23] In fact, the entire non-bauxite program was scrapped in September, 1943, by the Production Executive Committee headed by Charles E. Wilson of General Electric, although " a great outburst of protest " led to the temporary restoration of two alkali processes to the active list; one of the Monolith Portland Midwest Company of Laramie, Wisconsin, and the other of Ancor Corporation in South Carolina.[24] But no actual grants were made to them out of the meager $16,500,000 earmarked for non-bauxite methods.

Before telling the story of a promising process that was rejected, the Hixson-Miller process, it will be useful to have in mind the background of the critical raw material situation threatening the aluminum industry.

By May 14, 1941, Gibbons was able to report Alcoa bauxite stocks of only 131,000 tons, or enough to produce roughly 65,000,000 pounds of aluminum—an insignificant part of even the direct military requirements for 1941.[25] Submarine warfare was beginning to threaten bauxite shipments from the Guianas, where Alcoa customarily drew from 60 to 70 per cent of its bauxite, conserving the limited high-grade supply at home.

Economic and military implications are unpleasant. An aggressor snapping at the long shipping lines from South America or the Netherlands East Indies (where Alcoa and Reynolds, it is reported, have made such commitments as they could for post-war supply) could ruin our aviation. Of course we could prudently amass a huge stockpile against such emergency, improving on past performance in this regard. But even in a stable peace economy, the hydroelectric development implicit in anticipated industrialization of South America will draft large quantities of aluminum fashioned from local bauxite supplies; and the North American aluminum industry, if dependent on bauxite, will suffer.

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[23] Kalunite never got to the point of commercial production of alumina. In 1943 Kalunite was granted use of a plant financed by the DPC and costing $4,954,000, in order to produce alumina from alunite, a potash-aluminum ore, by a sulfuric-acid process. The plant, located near Salt Lake City, was to supply alumina to a DPC smelter in Tacoma, Washington, run by the Olin Corporation of East Alton, Illinois, which, in 1934, had bought a 90% interest in Kalunite. As the project was not successful, the Olin interests do not want to make aluminum in peacetime unless they are assured of an adequate and economical source of bauxite. *Truman Hearings*, part 7, p. 2127; "Aluminum: Have or Have Not? ", *Fortune*, December, 1943, p. 258.

[24] *Ibid.*, pp. 261, 266.

[25] *Truman Hearings*, part 3, p. 798.

During the war, Alcoa, geared to an aluminum production program aiming at a peak of over 2,000,000,000 pounds a year, and faced for a time with "fearful" losses of Guiana ore through submarine raids, stripped and mined newly discovered bauxite in the South, and picked over the known mines in states once scorned as sources.[26] Most of the gleanings were of such low grade as to require extra processing for use in the Bayer process. Three tons instead of two were needed for each ton of alumina produced. Freight and fuel costs reflected the extra bulk. Each pound of silica wasted one and a half pounds of alumina, and a pound each of soda ash and lime. To recover some of the lost alumina, Alcoa installed "red mud" reclamation equipment in the four alumina plants which it operated.[27] The equipment, which enabled the East St. Louis plant to digest bauxite which is 11 per cent silica, and made it possible to produce millions of pounds of additional alumina, cost the United States government $42,500,000.

Investment in non-bauxite alumina might have reaped a post-war harvest. Despite the freight economies of geographical integration with Pacific coast power facilities, ingot plants, and aviation production, we do not know whether alumina from northwestern clays can compete with high-grade bauxite imports used in the Bayer process. Nor can we know this until some new methods reach the scale of commercial operations, with the operating economies, technical reforms, and profitable use of by-products absent in the test-tube or even pilot-plant stages. It is conceivable that fear of post-war contraction of the aluminum market has inhibited the application of the new processes, especially since they have been vigorously pressed only by independents, although sometimes known to Alcoa.

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[26] "Aluminum: Have or Have Not?", *loc. cit.*, pp. 137, 265.

[27] *Ibid.*, p. 138.

THE HYDROCHLORIC METHOD

Professor A. W. Hixson of the Department of Chemical Engineering at Columbia University and Ralph Miller of the Chemical Foundation jointly developed a process for making alumina from clay, using hydrochloric acid.[28] Although this kind of method had been explored for half a century, Hixson and Miller invented the use of the selective organic solvent, isopropyl ether, to separate the iron impurities from the alumina. They also made it technically feasible to utilize a hydrochloric method on a large scale, adapting the experience of a new plant (announced November, 1940) which produced phenol using hydrochloric acid under severe conditions. The scientists saw no reason to broadcast their knowledge while Alcoa was serving the peacetime market, but the growing world crisis and the American defense program spurred them to action. They informed the Bureau of Mines of their work; OPM was notified, and requested that a committee of the National Academy of Sciences, OPM's technical adviser, meet with Miller and Hixson.[29]

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[28] Roasted clay is dissolved in concentrated hydrochloric acid leaving as waste insoluble silica. Ferric and aluminum chlorides which emerge are treated with isopropyl ether which separates out the iron, leaving alumina and hydrochloric acid. *Ibid.*, p. 262.

[29] The NAS was incorporated by Congressional act in March, 1863, to mobilize science for the Union cause in the Civil War. During the first World War it organized the National Research Council to concentrate its war activities. Later the NAS was made permanent by Presidential order. The NAS has lines to over fifty scientific societies. It has a quasi-governmental status, with the responsibility of advising federal agencies. See U. S. Senate, 77th Congress, 2nd Session, Committee on Military Affairs, *Hearings before a subcommittee on S. 2721. A Bill to establish an office of technological*

After some delay the matter was considered by the subcommittee on alumina of the NAS Metals Conservation and Substitution Group, of which Group Dr. Zay Jeffries, formerly connected with Alcoa, was chairman. Jeffries informed Miller on August 27, 1941, that the process was not thought to be far enough advanced for serious consideration. Even had the method been quite perfect, however, it is apparent that the Group had another objection to this clay-based process; for, said Jeffries, " Plans have already been made for the expansion of the aluminum industry on the basis of bauxite." (This was shortly after Alcoa had signed contracts with the DPC for alumina and aluminum plants.)

Specific criticisms (thought by Miller to be chiefly unfounded) were offered by the subcommittee. Miller was invited in January, 1942, to develop his process in the laboratories of the National Gypsum Company with the aid of the Buffalo Electro-Chemical Company (Becco). The process was revised on the basis of further laboratory work. The Academy received copies of the revised process in July, 1942 but granted neither audience nor reply to the inventors thereafter. It did, however, report adversely to the War Production Board (which had by then superseded OPM) on the request of Becco for a $250,000 government grant to launch the process in a pilot plant.[30]

Miller believed that the process had not received a fair hearing. There was no central agency coördinating all government technical resources and able both to analyze technical resources and to give financial aid to " people with ideas and limited resources ". Moreover, the Academy subcommittee on alumina had among its four members Francis C. Frary, director of research of Alcoa, and Robert S. Sherwin, alumina plant manager of Reynolds—people whom Miller thought incapable of unprejudiced decision on the question of a subsidy to a competing

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mobilization, and for other purposes (hereinafter cited as *Kilgore Hearings*), November 20, 25, 27, and December 4, 10, 11, 1942 (Washington, 1943), vol. 2, pp. 307-17.

[30] *Kilgore Hearings*, pp. 389, 411-13.

method. S. K. Colby, Alcoa's Vice-President, was also a member of the Academy's Metals Conservation and Substitution Group, no doubt invested with special authority on questions concerning aluminum, the metal with which he was familiar.

Colby and Jeffries, chairman of the Group and formerly with Alcoa, were both present at the exploratory meeting of December 19, 1929, between Alcoa and Dow Chemical Company, at which Alcoa tried to reconcile Dow to a three-cornered relationship with I. G. Farbenindustrie to control the world magnesium market. Jeffries later became Technical Director of the Lamp Department of General Electric and chairman of the board of directors of GE subsidiary Carboloy Co., Inc. In the latter capacity he was indicted in the anti-trust suit charging a GE-Krupp conspiracy to monopolize tungsten carbide through a patent pool and other devices.[31]

The WPB relied entirely on the NAS group for information on metals.[32]

A few months later the WPB gave Anaconda Copper Mining Company several hydrochloric acid processes for investigation. Although Anaconda recommended one which was identical with the revised Miller-National Gypsum-Becco process, no process of this kind was utilized by the WPB.

OLIN AND BONNEVILLE

Meanwhile the Olin Corporation was putting in its bid for a share in the aluminum reduction contracts. The Bonneville

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[31] No. 110-412 (Criminal) In the District Court of the United States for the Southern District of New York, October Term, 1941, United States of America v. General Electric Company, Friedrich Krupp Aktiengesellschaft, et al., Indictment Returned October 21, 1941.

[32] The NAS, as evaluated by M. M. Whitaker, naval architect testifying before the Kilgore Committee in favor of equal open licensing of patents through a central technical agency, "is largely composed of eminent scientists who are employees of the leading corporations of the country. It is human and natural to see the side which represents the individual meal ticket. Most of them . . . are of mature years. To a great extent they have become crystallized in their ideas and their viewpoint is conservative. They prefer things as they are rather than to venture into new and untried fields." *Kilgore Hearings,* p. 357.

Power Administration suggested that an aluminum plant of 30,000,000 pounds capacity, to be run by Olin, be set up in the Tacoma-Covington area. (Two other plants, one at Cascade Locks to be run by Alcoa, and one at Spokane to be operated by Union Carbide and Carbon Co., were contemplated by Bonneville to use available power in the Bonneville-Grand Coulee region.) The Bonneville suggestions conformed with the directive, expressed in the Bonneville Act, not to foster monopoly.

But Arthur Bunker of OPM eliminated Olin from the plans when, in an announcement of July 2, 1941, he transferred Olin's capacity to Alcoa at Cascade Locks. Later Paul Raver, Bonneville Administrator, was able to reinstate Olin at Tacoma by drawing on reserves for an extra 32,500 kilowatts. There were delays in securing definite authorization and signing the DPC contract. Bunker insisted that Olin agree to have Alcoa design the plant on a fee basis.[33] Faring westward, Mr. Chadwick of OPM selected a plant site for Kalunite in the state of Washington, with the advice of Alcoa's chief engineer, Mr. Jolly. Jolly objected to sites preferred by Kalunite because they were unsuitable for an electrode furnace, while Olin intended to use the Söderberg continuous electrode, making such a furnace unnecessary. Kalunite's president thought that the Jolly site lay " in stump country " far from tidewater and power, with " jerkwater " rail connections. He was convinced of a deliberate attempt to discourage him from production.

It was clear that OPM (represented in negotiations with Bonneville by Jesse Jones and Mr. Cortesi) wanted a single new plant to be built in the Northwest with a capacity of 165,000,000 pounds—as large as Alcoa's own plant at Vancouver. Raver opposed:

> We protested against having this additional block of aluminum concentrated in one plant . . . from an operating point of view, certainly Bonneville could provide this capacity much

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[33] *Truman Hearings*, part 7, p. 2203.

> more efficiently and at less cost and with much better operating conditions if this load was distributed over our transmission system instead of being concentrated at one spot. We recommended that the power load be divided up into at least 3 alumina plants. . . .
>
> In the second place, we have some responsibilities under the Bonneville Act for the development of this region and we felt . . . it was better to decentralize this large industry . . . to give a better balance to the economy of the region. We also felt that, from a national defense point of view, it was objectionable to concentrate these very important large loads in one spot. . . .
>
> Then the monopoly implications of the single-plant location also struck us rather forcibly. It was apparent and indeed it was asserted by the officials of OPM that the Government would have to have so vast a plant operated and managed by Alcoa, since only that company, according to these officials, had the requisite skill and managerial ability to run a plant of that size . . . it seems to me that if we have several plants out here, operated by independent operators, we have a much better chance of those plants continuing in operation after the emergency . . . than if the entire operation is under the control of the present monopoly. . . . Alcoa operates plants in many other parts of this country, even in Canada. If they control the entire aluminum production in the Northwest it will be their choice when this emergency is over, as to what plants will continue in operation, and the Government, not having developed any other operators, will be at their mercy in that decision.[34]

Although the small Olin plant was kept in the program, the Bohn and Union Carbide companies withdrew at their own initiative after being invited by the DPC to operate government aluminum plants. As both companies are thought to be friendly towards Alcoa, their withdrawal was interpreted by some as a sign of reluctance to compete against that company. Olin remained as the last remnant of Bonneville's program to subsidize independent producers as protection against future monopolistic restrictions.

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[34] *Truman Hearings*, pp. 2114-15.

REYNOLDS MAKES HEADWAY

The only other independent aluminum producer to make headway even in the era of expanding metal markets, the Reynolds Metals Company, did so without subsidy through the DPC. Before the war this company was one of the largest American consumers of aluminum ingot. In 1940 Richard S. Reynolds, President, looked ahead to war needs, and planned to make aluminum. He was unable to win encouragement or sponsorship from the National Defense Advisory Commission.[35] Finally, through the intervention of Senator Lister Hill of Alabama, the Reconstruction Finance Corporation granted Reynolds a loan, in August, 1940, to construct plants at Listerhill, Alabama, and Longview, Washington. The final amount of the loan was $20,000,000: $4,200,000 for the Washington plant, $15,800,000 for the Alabama plant.[36] The loan was secured by a first mortgage on the eighteen existing Reynolds plants, and Reynolds earmarked a percentage of future earnings for amortization. Thus, in sharp contrast to the assumption of all capital expense and risk by the DPC in building aluminum plants run by Alcoa in 1941 and 1942, Reynolds became a producer of aluminum ingot by pledging the firm's own assets to secure a government loan. That Reynolds was able to dig in at all was a tribute to the financial resources of the integrated Reynolds Metals Company, to the persistence of its president, and to the favorable condition of an expanding market.

According to Mr. Reynolds, Alcoa reduced ingot shipments to Reynolds by 40 or 50 per cent after the end of the testimony in the anti-trust case and the granting of the RFC loan in August, 1940. As a result, Reynolds Metals Company was forced to use up its flow-metal stock in order to maintain production.[37] It should be remembered that Reynolds had done business with Alcoa for fifteen years, fabricating aluminum foil, powder and paste from metal supplied by the monopoly.

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[35] *Truman Hearings*, part 3, p. 753.

[36] 77th Congress, 1st Session, House of Representatives, *Interim Report* No. 982, *Interim Report on Strategic and Critical Materials, Pursuant to H. Res.* 162, July 21, 1941, p. 7.

[37] *Truman Hearings*, part 3, p. 754.

The Reynolds plant at Listerhill was built in the record time of six months, producing aluminum for the first time on May 18, 1941. The hot rolling mill began operations less than two months later. The integrated plant is located on a square mile of northern Alabama cotton land, in the Muscle Shoals area of the TVA. It is near a source of reliable power and has access to water and rail transportation. Starting with high-grade bauxite from the Dutch East Indies, the plant later resorted to Caribbean, Brazilian and Guiana deposits and to domestic ores.[38]

Mr. Reynolds failed to obtain a portion of the DPC- financed capacity. Lacking further assets to mortgages, he asked that his company be permitted to lease government-owned aluminum plants. After the war, the government could keep them as stand-by plants, dismantle them, or permit Reynolds to buy them—in short, any compromise was favored that would take the burden of capital-raising off Reynolds' hands. He said he was willing to sell his aluminum plants to the government, shrink back into the fabricating business, and buy ingot from plants owned and operated by the government after the war. As the war progressed, however, public statements of company officials became quite definite about remaining permanently in the ingot business.

MAKING THE CONTRACTS

The Truman Committee hearings in May, 1941, needled OPM into action by revealing an imminent shortage of aluminum of over 600,000,000 pounds a year, despite drastic priorities and after taking into account all planned production. The response was slow, for it was not until July 15, 1941, that OPM began to designate the companies which were to produce the aluminum, although the Truman Committee had requested, in April, 1941, the facts on the extent of the shortage and steps taken to overcome it. Nor did OPM spread the favors of the new contracts broadly: Olin, Bohn, and Union Carbide were not invited to confer with DPC until September, 1941. Only Olin signed a contract.

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[38] H. C. Parmelee, "Aluminum—From Bauxite to Rolled Metal", *Engineering and Mining Journal*, vol. 144, No. 9, September, 1943, pp. 52-53.

Before Alcoa sat down to negotiate with DPC, it had ordered $4,000,000 of electrical and other equipment, apparently on the assumption that it would eventually be awarded a contract.[39]

OPM, which had never made any specific proposals to Alcoa, had nevertheless granted Alcoa a certificate requiring DPC to allot $50,000,000 to Alcoa at once. Furthermore, Alcoa was requested to draft a contract, as a basis for discussion, governing the terms of lease of DPC alumina plants to Alcoa. While the final version of this contract (signed August 19, 1941) was superior to the first draft, it still "contained few if any safeguards to the Government and was entirely too favorable to Alcoa." Many important subjects were left entirely to future negotiations by the parties, and Alcoa's concurrence was required in every proposal, although the government bore the entire expense. The August contract provided for an alumina plant in Camden, Arkansas, with 400,000,000 pounds capacity, and three aluminum plants in Massena, Arkansas, and Washington or Oregon, with a total planned capacity of 340,000,000 pounds.[40]

Severe criticism by the Truman Committee, roundly seconded by Secretary Ickes, caused modification of the original agreement through a supplemental agreement dated December 12, 1941, which not only eliminated many objectionable features but also provided for larger alumina and aluminum capacity. The DPC alone now gained power to determine the price at which it furnished bauxite to the leased alumina plant. (For Alcoa's protection against a discriminatory price, the bauxite so furnished was not to cost Alcoa more than the market price, or the price at which Alcoa supplied its own bauxite.) The DPC alone could now determine the rates and periods of alumina production, with the proviso that enough be produced to supply the leased smelters (run by Alcoa).

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[39] If Alcoa did not get the expected contract, the order stipulated that the equipment would go to the firms that did. 77th Congress, 2nd Session, *Additional Report of the Special Committee Investigating the National Defense Program, Pursuant to S. Res. 71*, January 15, 1942, *Sen. Rep.* No. 480, part 5, p. 16.

[40] *Truman Hearings*, part 7, p. 2284.

The DPC unilaterally could determine the price at which alumina was sold to the leased smelters or to others, and could fix the price of aluminum within the limit of what the DPC considered "a reasonable profit". Without consulting Alcoa, the DPC could allocate alumina among all smelters and was empowered to fix the rate of operation in all plants leased to Alcoa. Thus it could prevent Alcoa from slowing or suspending operations to protect the price of output of Alcoa's owned plants. Also it could make Alcoa provide an alumina supply to such independent smelters as were able to storm OPM.[41]

Both the August and December contracts allowed Alcoa to retain 15 per cent of the net profits in DPC plants, as its management fee. In addition, the August contract gave Alcoa liberal allowances for overhead, which were made less generous by the December amendment.[42] In the interim between the two contracts, Alcoa agreed to reduce its ingot price from 17 cents to 15 cents, effective September 30, 1941.

WHAT PRICE ALUMINUM?

Meanwhile, Jesse Jones, Secretary of Commerce and head of the Metals Reserve Company, was completing arrangements to purchase 340,000 metric tons of aluminum from the Aluminum Company of Canada (Alcan), under terms which put the

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[41] *S. Rep.* No. 480, part 5, p. 17.

[42] The August contract permitted Alcoa to allocate to the cost of production in the leased plants some items not directly chargeable thereto. Changes in the December version, it was estimated, would save the government almost $2,000,000. *Ibid.*

United States government in the position of financing the Shipshaw power development. The Alcan contract called for a price of 17 cents with an escalator clause if freight rates and labor costs should increase, while Alcoa, Alcan's southern twin (controlled by the same group of stockholders), was announcing a 2-cent price cut. The escalator addition was estimated by the Special Committee on War Expenditures, reporting to the Canadian House of Commons, as 3.51 cents in 1942 and 5.75 cents in the first half of 1943.[43] The liberal Alcan contract compensated for the effect of the Alcoa price reduction on the profits of Alcoa-Alcan stockholders. The details of the Alcan contract were not made public by Secretary Jones until the transaction was mentioned in the Canadian House of Commons in the spring of 1943. But Jones, while making the far-reaching commitments to Alcan, told the Truman Committee that he would lend DPC funds to Reynolds and Olin to build up competitors to Alcoa. He said he would channel to Alcoa only half of the total planned aluminum capacity of 1,500,000,000 pounds.[44] Finally, of course, it was revealed that Bohn and Union Carbide had withdrawn from negotiations with the DPC, and their planned capacity in Spokane and Los Angeles was taken over by Alcoa. Only the DPC plant in Tacoma, with a planned capacity of 30,000,000 pounds, run by Olin, was left of the proposals, endorsed in public by Jones, to bring in new producers and build up competition.

As the aroused Truman Committee was pointing out, there was no real justification for an ingot price as high as 17 cents; for, instead of bearing the cost of power facilities to feed the multiplying pot lines (at the rate of 10 kilowatt hours per pound of aluminum), Alcoa was able to buy 70 per cent or more of the power it used from the United States government, at modest prices of 2½ to 3½ mills per kilowatt-hour.[45] As the investment in reduction facilities was 15 to 20 cents for every pound of production capacity, and in power facilities, 25 to 30 cents, the assumption of the latter cost by the government considerably lightened the capital advance to be compensated out of profits. Special five-year amortization of privately built reduction plants meant that earnings currently taxable were substantially reduced. Alcoa abandoned the program of building with its own funds three plants at Alcoa, Tennessee, Massena, New York, and Vancouver, Washington when it learned in May, 1940, that DPC funds would be available.[46]

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[43] Estabrook & Co., *Aluminium Limited* (New York, 1944), p. 17.

[44] *Truman Hearings*, part 7, p. 2250.

[45] *Ibid.*, part 3, p. 741.

In recent years Alcoa's only new hydroelectric developments were those at the Glenville and Nantahala projects (yielding 60,000 kw.) which Alcoa began to plan in 1939; for the Federal Power Commission had ruled that those projects did not require a federal license providing for eventual recapture. When Alcoa's Fontana project, second only to Norris Dam in storage space in the basin of the Tennessee River, was declared subject to such a license, Alcoa withdrew its plans and application and sat tight. As the United States government had no means of forcing private investment in this important project, TVA finally bought the site from Alcoa and expanded the supply of TVA energy to Alcoa's plants. G. R. Gibbons, Alcoa Vice-President, told the Truman Committee that Alcoa thought it "much smarter" to use TVA power than to develop Fontana on FPC terms. The shortage of primary power (secondary power being available only 70 to 75 per cent of the time) was acute enough to require rationing of power and curtailing of civilian uses in a large part of the Southeast.[47]

The TVA-Fontana arrangement, while less favorable to Alcoa than the latter's proposal to develop the site on government funds, retaining title, was by no means without advantages to

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[46] *Ibid.*, part 8, p. 2659.

[47] *Ibid.*, part 3, pp. 803, 938. The aluminum industry in 1936 consumed enough energy in the electric cells which turn out the metal to fill the needs of 3,000,000 residential customers. Federal Power Commission, *18th Annual Report*, 1937-38, p. 27.

Alcoa, for the company had become thoroughly acclimated to absorbing large portions of the total power output of TVA, Bonneville, and other government projects. For instance, Alcoa used over half the installed capacity of Bonneville in 1941. The low cost of government power made available to Alcoa contrasted favorably with the high costs and risks of private capital development which might bring no return in idle years.

CHOOSING POST-WAR POLICY

Once wartime expansion of capacity and of production has taken place, it is possible (although not certain by any means) that large production will continue in peacetime. Decisive in determining the outcome are: (1) the over-all policy which the community adopts with reference to the level of production and employment, (2) the specific policy integrating the particular industry into the projected general policy, and (3) the successful execution of these policies. Discussion of general policy and of detailed administration lies outside the scope of this study. The following factors influence the specific policy: (1) what firms or agencies own and operate the war plants, and their relative influence in Washington; (2) how war plants are located and designed, factors which affect operating costs and determine whether plants would become submarginal at lower price levels; and (3) the terms on which government plant is made available for post-war use.

From the circumstances already described, which led to the concentration of production in Alcoa's hands and to the exclusion of independent producers, it can be seen that defenders of permanent reduction of production would find some strong support in Washington. This would imply great cutbacks of production to as near pre-war levels as possible, distribution of a limited amount of aluminum at protected monopoly prices, and lack of interest in programs for developing broader and competitive markets for aluminum. The pent-up civilian demand for aluminum is chiefly based on pre-war applications. If all these demands were met as quickly as possible and even if prices were very low, old uses would certainly not require capacity operation of existing facilities. The real future of the industry depends on the development of new markets. Monopoly conditions are a barrier to such development, if only because industrial buyers of aluminum might prefer not to be dependent on a material having only one domestic source of supply. But even if those opposed to monopoly were clearly in control of policy, government aluminum facilities could not be operated for some time at or near capacity, unless the government were to accumulate vast stockpiles of aluminum. Only after the gradual, firm establishment of competition would markets be large enough to warrant capacity operation of all the economical facilities now available.

As was indicated above, in December, 1943, 96 per cent of the alumina produced came from the four plants owned or operated by Alcoa, at East St. Louis, Mobile, Baton Rouge, and Hurricane Creek, Arkansas. The remaining 4 per cent was produced by Reynolds at Listerhill. Of the aluminum production in sixteen electrolytic reduction plants, 93 per cent was turned out by Alcoa as owner or manager, with about 50 per cent actually coming from Alcoa-owned plants. Together Olin and Reynolds made up the remaining 7 per cent.

> Many DPC plants were built originally to be operated as part of Alcoa's system, not to be the basis of competition. Consequently neither their location nor their size make [sic] it possible to realize the benefits of integration. . .One of the DPC ingot plants is located at Massena (NY) where Alcoa's private plants have been the predominant manufacturing industry for over 30 years and where the railroad and power facilities are also Alcoa-owned. The nearest non-Alcoa source of alumina is Hurricane Creek (Ark.), the nearest non-Alcoa fabricating outlet is hundreds of miles away. Independent operation of this plant, in competition with Alcoa, would be wholly impracticable. . .The DPC units are so scattered, from Tacoma (Wash) to Baton Rouge (La), from Los Angeles (Cal) to Massena (NY), that little integration has been

> achieved. The only major instance of real integration is the dovetailing of the Listerhill (Ala) DPC sheet mill with the private Reynolds Metals' ingot and alumina plants which are contiguous to it. Arkansas has a DPC alumina plant in its bauxite area and a DPC ingot plant nearby, requiring much less transportation from the mining of bauxite to the production of ingot than any other group of facilities in the country...The Pacific Northwest ingot plants...need a West Coast alumina plant because the rail haul from the midwest is too costly for postwar operation...Many of the giant plants...must be divided into smaller units...if they are to be brought into balance with the other facilities.[48]

Some of the DPC plants are excessively large from the standpoint of independent postwar operation because Alcoa, which carried through the bulk of the expansion program, had to spread its managerial and supervisory personnel very thin.[49]

Reconversion of the aluminum industry began quite early. In November, 1943, Arthur Bunker, speaking for the WPB, announced that, with aluminum production in that month seven times as great as four years earlier, there was a surplus of 97,000,000 pounds of available supplies over allotments for the last quarter of 1943. Despite persistent bottlenecks, and planned capacity extensions in certain finishing processes (for example, forgings and extrusions), the nation had passed the peak of war needs. Bunker therefore invited producers of war materials and essential civilian goods to submit estimates of aluminum needs to supplant war substitutes. Manufacturers were asked to state the intended uses to which the aluminum would be put and the advantages offered by aluminum in their work (such as saving in weight or in the time of machining or fabrication).[50]

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[48] Report of the Attorney General of the United States, Prepared pursuant to the provisions of Section 205 of the War Mobilization and Reconversion Act of 1944, on Aluminum, Washington, D. C., September 11, 1945, pp. 64-66.

[49] *Ibid.*, p. 44.

[50] *New York Herald Tribune*, November 7, 1943.

Less than two months later, Bunker announced a reversal of policy. Four aluminum production lines in two DPC plants run by Alcoa were ordered closed (Burlington, New Jersey, and Maspeth, Long Island). This was seen as the beginning of a sweeping cutback. Alcoa began to cutback its owned-plant production, apparently with WPB approval, by curtailing output at Alcoa, Tennessee, Badin, and Massena, and by putting into effect a 50 per cent reduction in alumina output at Baton Rouge, and a 10 per cent reduction at East St. Louis. Bunker announced that DPC plants at Badin and Massena would close on January 30, 1944. The over-all reduction for the United States amounted to 14 per cent of production. Bunker attributed the cutback to the surplus of production over military needs, as the country had already built up a stockpile for the 1944 aircraft program and that program was being scaled down. He did not explain, however, why capacity was not diverted to civilian needs as he had announced in November. Specific cutbacks in Burlington and Maspeth were defended because of the drain of coal for electrical energy (15 pounds cf coal for 1 pound of aluminum) and the long-haul transportation of alumina from the Mississippi Valley by rail. Less than six weeks before these cutbacks the Maspeth plant had been described as finally attaining capacity operations. (Construction of this $33,000,000 DPC plant had begun in February, 1942 on Queens swamp land.)[51] On the same day (December 24, 1943) that the WPB ordered shutdowns at Badin and Alcoa, Tennessee, it issued an order continuing restrictions on the use and delivery of aluminum paints and pigments.

On January 7, 1944, cutbacks amounting to 40 per cent of production were announced, covering fourteen units, for the next few weeks. Specific cutbacks followed in only three units. On June 14, 1944, the DPC alumina plant at Baton Rouge was reported to be in the process of decommissioning over a fortyday period. Run by an Alcoa subsidiary, Aluminum Ore Company, the plant was being reduced to a stand-by basis.

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[51] *New York Herald Tribune,* November 21, 1943.

Finally, on July 15, 1944, the WPB released aluminum for civilian use (but not where men, materials or facilities needed for war production would be employed in such use). Over fifty classes of items, including kitchen utensils, collapsible tubes, and other articles in which aluminum could replace metals used in the past and which manufacturers had been authorized to produce, were listed.[52] Manufacturers could ask WPB for permission to use aluminum beyond the limits of dollar volume or number of units fixed, and in uses not listed. This step represented a partial victory for the groups advocating a shift in the aluminum flow rather than the drying up of part of the flow. But cutbacks already put into effect were not generally reversed.

Other problems have been merely deferred. These include the disposal of wartime plants and the control of Alcoa's output and price policy. To ensure utilization of the greatest part of its wartime investment the government might: (1) sell or lease its plants to independents at favorable prices; (2) lease to Alcoa such plants as were integrated into its production system and not attractive to outsiders under terms working towards large minimum production and low prices; (3) operate its own plants as public enterprises, selling to aluminum fabricators who would welcome independence of the monopoly supply. Practical policy, as delimited by the final decision in the aluminum case, and by the Surplus Property Act of 1944, will probably favor alternative (1). (See Chapter X.) Some of the least economical plants may have to be shut down or retained as emergency facilities, for example, Maspeth.

MAGNESIUM EXPANSION BY DOW

Primary magnesium production in 1939 by Dow, the only domestic producer in that year, was 7 million pounds; in 1940 it was 12.5 million pounds, and in that year Dow made arrangements to increase capacity at Midland to 18 million pounds. Of this new capacity to produce, 2.5 million pounds was financed by the British Government. By April, 1941, Midland brine was yielding magnesium at the annual rate of 15.5 million pounds. As the growing demand for magnesium was destroying the joint-product balance of production from Midland brines, Dow turned to seawater for new sources of magnesium chloride, and set up a 12 million pound plant at Freeport, Texas, on the estuary of the Brazos River. The British Government financed the building of facilities at Freeport for an extra 6 million pounds a year.

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[52] *New York Times*, July 16, 1944.

> In February 1941 the United States Government for the first time provided capital for the expansion of magnesium, and authorized the construction of facilities by Dow Chemical for the production of an additional 18,000,000 pounds of magnesium per annum at the Freeport, Tex., plant. This increased the rated annual capacity of Dow Chemical to 54,000,000 pounds. In June of 1941 facilities for the production of 72,000,000 pounds annually were financed by the Defense Plant Corporation for a subsidiary corporation of Dow Chemical, known as the Dow Magnesium Co. These facilities were located at Velasco, Tex., where again sea water could be used as the source of magnesium chloride. Thereafter, Dow Magnesium Co. was authorized to construct additional facilities at Marysville, Mich., to produce 72,000,000 pounds annually. This latter project, however, required more magnesium chloride than could be obtained as a by-product from the regular operations of the Dow Chemical and it was necessary, in order to operate the Marysville project, to establish facilities at Ludington, Mich., to provide the additional magnesium chloride.[53]

[53] 78th Congress, 2nd Session, Senate Report No. 10, Part 17, *Additional Report of the Special Committee Investigating the National Program pursuant to S. Res. 71, Magnesium* [Truman Report on Magnesium], March 13, 1944, pp. 12-13.

OTHER PRODUCTION

Dow provided " know how " for a fee to two licensees, the Diamond Magnesium Company at Painesville, Ohio, which used magnesium chloride obtained from dolomite, and the International Minerals and Chemicals Company, producing magnesium from potash liquors and dolomite at Austin, Texas. Both these independents were financed by DPC funds. In California, the Permanente Metals Corporation, sponsored by Henry J. Kaiser on " money borrowed on his own risk from the RFC " and using a carbothermal process, did not produce much metal. But in the words of the Truman Committee:

> The production by Henry J. Kaiser has been of great value to the program because it was obtained when the scarcity was great. Future production will be very valuable because in this particular type of process the magnesium is first produced in powder form and can be used directly in incendiary bombs and pyrotechnics. The magnesium produced by others requires further processing before it can be used for their purposes.[54]

Mathieson Alkali Works, Inc., began producing magnesium and chlorine at Lake Charles, La., using the Dow cell. Later Mathieson developed its own electrolytic cell and so avoided payment of " know how " fees to the Dow Company. This revised method was approved by the War Department on December 30, 1941, although contract negotiations had begun in June, 1941. Delays in getting materials and in starting production held up commercial operations until June, 1943. Costs remained very high (82.4c a pound in November, 1943), but the WPB thought the plant might produce at lower cost once it achieved economies of operation.[55]

As the ferrosilicon process, while high in cost, used little power, it was recommended by the National Academy of Sciences as an emergency method to meet aircraft and incendiary bomb requirements. This process can be fueled by gas. " Even where electricity is used, less power is required per pound of magnesium than by the electrolytic method ". The ferrosilicon process which was finally used was developed through extensive research financed by the United States Government. The following facilities, costing the government $52,300,000, were established as part of the second expansion program:

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[54] *Ibid.*, p. 19.

[55] *Ibid.*, pp. 15-16.

	Annual Capacity in Pounds
Ford Motor Co., Dearborn, Mich.	40,000,000
Permanente Metals Corporation, Lathrop, Calif.	20,000,000
New England Lime Co., Canaan, Conn.	10,000,000
Magnesium Reduction Co., Luckey, Ohio	10,000,000
Amco Magnesium Corporation, Wingdale, N. Y.	10,000,000
Electro-Metallurgical Corporation, Spokane, Wash.	48,000,000
Total	138,000,000 [56]

But technical difficulties kept the government's investment in ferrosilicon plants from yielding expected returns in production. In July, 1943, production in all six ferrosilicon plants was only 4,181,146 pounds, or about 40% of the 10,666,500 pounds " rated monthly capacity for full operation." By January, 1944, production had climbed to 6,560,942 pounds.

THE BASIC FIASCO

When estimates of magnesium needs were revised upwards in the spring of 1941, Mr. Sidney Hillman of OPM advised the War Department that companies other than Dow be used to create 89 million pounds new capacity. Part of this increase was allocated to Basic Refractories, Inc., of Cleveland, Ohio, and to Magnesium Elektron, Ltd. Basic Refractories was engaged in the manufacture of magnesite refractories used in lining basic steel furnaces. Near brucite and magnesite deposits leased by the company in Nye County, Nevada, Basic Refractories had staked claims to other deposits of magnesium-bearing ones, carried in the name of a subsidiary, Basic Ores Company. Through a Canadian affiliate, Basic Refractories gained contact with Magnesium Elektron, which had been formed in England in 1935 to produce magnesium electrolytically from ores, under an I. G. Farben patent made available to it through Imperial Chemical Industries.

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[56] *Ibid.*, p. 19.

Basic and Elektron agreed in April, 1941, to produce magnesium in the United States if funds could be obtained from the United States Government. The collaboration would make the Basic ores (carried at a book value of $25,000) valuable, by using Magnesium Elektron technique and patent rights to produce magnesium. However, as a licensee of I. G. in England, Elektron had no right to extend patent privileges in the United States, especially since Magnesium Development Corporation (disbanded by the 1942 consent decree), held the American patent rights. Since the decree abrogating patent restrictions on magnesium production applied only to the war period, possible patent conflicts darkened the future of the Basic plan, so that the government was undertaking a dubious bargain in paying for Elektron's tenuous patent rights. Elektron had made it clear that this process was adapted to dolomite (rather than magnesite, which Basic contributed). The allocation of 12 million pounds of capacity to Basic was coolly received by Elektron, which succeeded in increasing the project to 112 million pounds to cost about $64,000,000. The British and American companies formed a joint company, Basic Magnesium, 55% of whose stock went to Basic Refractories, and 45% to Elektron.[57] In August, 1941, Basic Magnesium contracted with DPC to design the plant and manage its building and operation. The Truman Committee was of the opinion that the return which Basic Refractories received for this was " unduly favorable " in view of its " very small " investment and lack of experience.[58]

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[57] *Ibid.*, p. 26.

[58] Its construction fee was to be one-half of 1% of the cost of building (but not more than $300,000), and its management fee was to be a royalty

The total cost per pound capacity of magnesium obtained was $1.181, which was high, compared with 79.1c at Dow's Velasco plant, and 42.7c. at Diamond Magnesium. Nor was any risk, or provision of capital, or pledge of assets undertaken by Basic Magnesium. In building the project, those in charge displayed so much "demonstrated incompetence" and extravagance, that the construction cost was double the original estimate.[59] As a site removed from vital supplies of ore and power was selected, extra transportation expense was created, and critical materials were used in a fleet of trucks. (The plant itself was so ill-placed on its site that the railroad terminal was set at the lowest point and all materials had to be carried upgrade to be used!) Delay in getting Basic under way was attributed by the Truman Committee to DPC, which in turn blamed OPM and the War Department. The poor planning of the project was reflected in failure to attain production goals, as well as in high costs.[60]

At the request of the government, Anaconda Copper took over the control of Basic Magnesium and the operation of the

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on production of at least ½c. per pound, or 2% of sales value. Also, the ore property was to be leased to the government for another royalty of 1% of the metal production, or at least ¼c. per pound of magnesium. (This was never put into effect, as it was discovered that at the contemplated production rate of 112 million pounds a year, Basic would have received $280,000 a year in ore royalties—although the total investment had been less than one-tenth that amount—as well as $560,000 a year for operating the plant.) According to the contract, if the DPC sold the plant at the end of three years, Basic would have first option to buy it, and, if it failed to exercise the option, would get a "consolation prize" of $1,000,000 and double royalties on mined ore, plus protection against competition in the refractories business.

[59] *Ibid.*, p. 31.

[60] The metal plant bore no direct technical relation to the mining and ore treatment plant, for the magnesium plant was built after English design, adapted to dolomite rather than magnesite. Not enough work had been done to determine whether an ample supply of ore was available, and how much of it was made useless by impurities. Basic apparently delayed adverse testing reports (made by its own experts) on the quality of the ore, and opposed the government technicians who wanted to use nearer sources of magnesium than the Basic deposits, to improve efficiency. The view of Basic prevailed upon the DPC, which did not acquire nearby claims belonging to other interests.

plant on October 26, 1942, and introduced needed reforms. By July, 1943, the plant had attained capacity operations.[61] By March, 1944, the Truman Committee was able to say that this plant, the largest magnesium plant in the world, had produced about 25% of all the magnesium made in government-owned facilities, and that in 1943 its production had amounted to 39% of all the magnesium turned out by private and public plants in that year.[62]

VIEW OF TRUMAN COMMITTEE

The first report of the Truman Committee on magnesium favored giving audience and aid to the carbothermal processes of Hansgirg and Doerner, rather than devoting further funds to the ferrosilicon process which " appeared to the subcommittee to be a more expensive process ".

> The subcommittee considers it of prime importance that these huge plants constructed with Government funds be built around the most economical processes available, to the end that they may compete commercially after this war. . . . The monopoly on magnesium production which has prevailed in the past should not be permitted to continue.[63]

The subcommittee also criticized the uneconomic Basic venture, urging that the original " exorbitant royalty terms " proposed by Basic be rejected by DPC as reflecting " one of the most flagrant attempts at war profiteering to come to its notice ".

The later report on magnesium defended an electrolytic process using California serpentine rock, and criticized the WPB for not giving "instant and full encouragement" to a process promising to be cheap and "sponsored by businessmen of substance willing to proceed at their own expense, and approved by a well-known and reputable scientific laboratory."[64]

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[61] Anaconda had previously shown interest in light metals. Shortly after the first World War, it took options on 2,000 acres of clay lands near Spokane, Wash., and held them while experimenting in Montana on the production of aluminum from clay. (Letter from Sheldon L. Glover, Department of Conservation and Development, State of Washington, April 4, 1944.)

[62] *Truman Report on Magnesium*, p. 59.

[63] 77th Congress, 2nd Session, Senate Report No. 480, Part 6, *Additional Report of the Special Committee Investigating the National Defense Program pursuant to S. Res. 71*, April 6, 1942, p. 3.

THE RECORD OF EXPANSION

Up to March, 1944, the government spent $370,000,000 on magnesium plants, of which only 5 were still operating below capacity. Twelve of the thirteen had received twice as much from the government in operating expenses as they had turned out in magnesium valued at then current prices.[65] Still, magnesium ingot production was bountiful in relation to storage space and fabricating facilities, a situation reflecting both the continuing shortage of finishing facilities and the remarkable expansion of production, which in 1943 was 368.2 million pounds compared with 98 million pounds in 1942.[66]

The role of Dow was of central importance, especially in 1942, in which year Dow facilities, privately and publicly owned, produced 84.2% of all the metallic magnesium in the United States,[67] and the Dow group including two licensees produced 91.2%. The Dow group, which had 44% of the rated capacity in 1943 of 580,000,000 pounds, produced in that year 60% of the magnesium.[68] The reasons for its superior contribution were the mismanagement of Basic under its first set of owners, the failure of the ferrosilicon process to produce up to capacity, and the early technical difficulties of Kaiser's Permanente plant. The Dow group had the advantage of employing personnel experienced in the practical application of a tried and perfected process. The technical and economic performance of Dow and its licensees fully measured up to the engineering possibilities and cost relations of the electrolytic process based on brine. Government aid to the group, estimated by Dow at roughly $150,000,000, was important in allowing the rapid expansion of production. It is too bad that while funds were wasted on the Basic fiasco and the ill-fated ferrosilicon process, carbothermal processes, which are potentially cheaper than electrolytic production, were not subsidized. It would be desirable to have been developed for future use, so that the consuming public might benefit from diverse sources of cheap magnesium.

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[64] *Truman Report on Magnesium*, p. 52.

[65] *Ibid.*, p. 54.

[66] War Production Board, Facts for Industry Series.

[67] "Dow and Magnesium", p. iv.

[68] *Ibid.*, pp. 50-51; *Truman Report on Magnesium*, p. 13.

The payment of a "consideration" by Dow's satellites and by the DPC projects at Velasco, Texas, Marysville and Ludington, Mich., for the use of "know how and patent immunity" would appear to conceal the equivalent of a royalty, although the 1942 consent decree made royalties illegal and threw open the use of Dow's production processes and patents for the duration of the war.[69]

In March, 1944, cutbacks in magnesium orders began. In July, 1944, the WPB released aluminum and magnesium for civilian use. As no large civilian channels for magnesium existed, the WPB order affected mainly experimental production (e. g., of rolling stock models and truck chassis).[70] A few days later, five government-owned magnesium plants were cut back, with the explanation that surplus stocks were growing. By the end of November, Diamond Magnesium had been partly closed down and nine government-owned plants had been ordered closed.[71] The WPB order of July did not end the government's allocation of magnesium ingot, or permit its use in civilian goods not then made. The Dow Chemical Company urged that these controls be revoked, to permit development of peacetime markets and to prevent unemployment and destruction of the industry. Revocation of the controls followed in October as military use of the metal decreased and surpluses piled up.[72]

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[69] *Truman Report on Magnesium*, p. 14. The decree left it to Dow and DPC to decide how much of the "consideration" which Dow was to receive was legitimate under the decree. Negotiations between the parties decided that "until predetermined quantities of magnesium have been produced, payments will be made to Dow Chemical Company based on one-half or two-thirds cents per pound of magnesium". These payments were in addition to construction fees for four plants, totalling about $1,300,000, and annual fees for managing the DPC plants at Ludington and Velasco, at $360,000 per plant. The fees paid for "know-how and patent immunity" until the time of the Truman report were: $2,764,666 from Velasco and Diamond; $614,400 from International; $1,000,000 from Ludington. The wording of the arrangement would suggest that the decree was not closely followed in DPC negotiations.

[70] *New York Times*, July 16, 1944.

The experience of war production of magnesium has resembled that of aluminum in some respects: 1) The established monopolist retained a very substantial share of the expanded war market and ably performed its contract obligations. 2) One independent made headway (Kaiser in magnesium, compared with Reynolds in aluminum) on his own risk, but with the aid of RFC funds in the form of a loan and not of simple subsidy. 3) Whether postwar supplies will be scarce or ample depends on public policy in encouraging active use of DPC plants, granting power subsidies, and aiding new methods.

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[71] Basic, Permanente, Amco, Mathieson, International Minerals and Chemicals, Ford, Dow Magnesium Company plants at Marysville and Ludington, Mich., and Velasco, Tex., and Electro-Metallurgical Company, Spokane.

[72] *New York Times*, November 25, 1944; *New York Herald Tribune*, August 14, 1944.

CHAPTER X

THE GOVERNMENT'S SHARE: POLICY, PAST AND FUTURE

An important role in the creation of the modern Alcoa belongs to the policy of the United States government, which will be reviewed in the first section of this chapter. The social performance of the aluminum industry can be judged in terms of meeting of consumers' need for a steady supply of cheap aluminum in useful forms, and of the provision of stable, high-level employment for aluminum workers. Policies to improve the social performance of the industry are discussed in the second part of this chapter. Thus the double-edged possibilities of government policies will be revealed.

Federal policy built a tariff wall which protected Alcoa's prices and profits against European competition during important periods of Alcoa's rise to power. War orders made possible expansion of capacity and the accumulation of profits on which to base postwar growth and control. These positive aids to Alcoa were supplemented by the government's passive assistance in tolerating monopolistic activities, or, at best, in tardily deploring past events. The high value of toleration to Alcoa is suggested by events following the anti-trust suit which, argued before the lower court from 1937 to 1941, was a really serious and comprehensive anti-monopoly activity of the government. Although the market expansion of the first World War had not been accompanied by the emergence of competitors, and aluminum prices had risen sharply, yet in the second World War the Reynolds Metals Company entered the field, and prices were cut from 20 cents in 1939 to 15 cents in 1941. It is true that other commodity prices rose more in the first war than in the second. Still, in the period 1939-41, while the price of virgin aluminum was being reduced, not only was the wholesale price level (as reported by the Bureau of Labor Statistics) rising noticeably, but American quoted prices of such metals as tin, copper, zinc, and steel scrap, showed definite increases. (Copper rose 1/5 between June, 1939, and June, 1941; steel scrap, about 1/3; and zinc about 3/5. The annual average price of tin rose less than 1/12 between 1939 and 1941.)

TARIFF AND PATENT PROTECTION

In Alcoa's earlier years, the growth of monopoly power was aided by tariffs, patent monopoly, and lack of vigorous anti-trust action. The following table summarizes the tariff history of aluminum. (Similar protection, of course, has been granted to many other manufacturers over the long course of American tariff history.) The inclusion of utensils and other manufactures in 1894 made the protection more effective despite reduction of the ingot duty from 15 to 10 cents. The further reduction of the ingot rate in 1897 was accompanied by higher rates on fabricated goods and by the specific protection of aluminum sheet. Aided by falling costs, Alcoa did not suffer from the partial tariff reduction and was able to stabilize prices at 33 cents a pound until the 1905 boom. Then Alcoa increased prices (reaching its twentieth century high of 38 cents in 1907) to take full advantage of the growing demand.

IMPORT DUTIES ON ALUMINUM INGOT AND FABRICATED PRODUCTS [1]
1890-1939

Years	Ingot	Sheet	Foil	Utensils	Other Manufactures
1890-4	15c.				
1894-7	10c.	*	*	35%	35%
1897-1909	8c.	13c.	*	45%	45%
1909-13	7c.	11c.	*	45%	45%
1913-22	2c.	3.5c.	*	25%	20%
1922-30	5c.	9c.	35%	11c. + 55%	40%
1930-9	4c.	7c.	40%	8.5c. + 40%	45%

c. per pound
% ad valorem
* No separate classification of these items in the year indicated

[1] Equity No. 85-73, Opinion of the Hon. Francis G. Caffey, p. 411.

Meanwhile, although Alcoa's own patent (the Hall patent) protecting the basic method of aluminum production expired in 1906, Alcoa's campaign to usher the Cowles Company out of the aluminum industry had led to a victorious agreement in 1903, which conveyed to Alcoa exclusive use of the Cowles-owned Bradley patent until it expired in 1909. While it was doubly secured by patent and tariff, Alcoa was able to amass important reserves of domestic bauxite and power rights, preventing its suppliers from serving possible competitors by means of restrictive covenants. Because of the expanding market, Alcoa was able to enlarge its corporate reserves after 1905. In 1909 Alcoa established a firm foothold in the fabricating field, commanding important sales outlets and closing them to future competitors. When the tariff on ingot and sheet was lowered in 1909, and the Bradley patent expired, Alcoa was faced by foreign competition in its home market, but by no domestic competitors.

THE DECREE OF 1912

On June 7, 1912, after an investigation by the Department of Justice to detect violations of the Sherman Act by Alcoa, a consent decree was entered in Western Pennsylvania against the aluminum monopoly. The agreement of 1908, dividing world markets between Alcoa's Canadian subsidiary, Northern Aluminum Company, Ltd., and the Swiss aluminum company was cancelled, and future agreements affecting sales in the United States, imports, and prices of imports of aluminum and its raw materials, were enjoined. The decree cancelled restrictive covenants which Alcoa had made with bauxite and alumina suppliers, and an agreement restraining competition from certain interests in the Aluminum Goods Manufacturing Company, in which Alcoa had acquired a part interest. All undue discrimination against competitors in any branch of the aluminum industry was forbidden.[2] Although a consent decree entails no admission that the defendant committed illegal acts in the past and affects only future behavior, still, the appeals court decision of 1945 referred to "unlawful practices" of Alcoa from 1909 to 1912. (See below p. 246.)

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[2] Prohibited were: control of the output or price of any aluminum product, delaying or refusing shipments of material arbitrarily, charging competitors

At the request of Arthur V. Davis, the clause enjoining agreements concerning sales of aluminum in the United States was inserted in the part of the decree affecting international agreements. Davis had asked the Attorney General for permission to make agreements with the European producers, but said the contemplated cartel would not affect the United States market. The Attorney General acquiesced.[3] As explained in Chapter V, the Department of Justice in its 1937 suit questioned the sincerity of the exclusion of the United States from the 1912 cartel, especially as aluminum prices in this country rose sharply in the year of the new agreement. The agreement was finally executed only three days after the consent decree. The cancellation of the restrictive covenants was not effective in promoting competition, as future acts of exclusion were not covered. The restrictive covenants in hydro power were not mentioned. Provisos in the decree permitted Alcoa to quote special prices, and to refuse to deal with certain customers. The injunction against discriminatory practices was poorly enforced in the 1920's. As it worked out, the decree deferred in principle to the public feeling against monopoly but had no real force.

WARTIME CHANGES

The re-formation of orderly world relations by the 1912 cartel partially protected Alcoa against imports but the lowered rates of the Underwood tariff of 1913 were a counteracting influence. The cartel was disbanded in 1915, as the war disrupted normal commercial relations. Cartel members enjoyed large markets and had to increase capacity rather than dump sur-

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higher prices for aluminum than Alcoa's own fabricating companies were charged, refusing sale of aluminum to potential fabricating competitors, and other related practices discouraging to competition.

[3] Equity No. 85-73, Exhibit 1011.

pluses. This temporarily removed the potential competition formerly bridled by the cartels.

Imports, continued growth in production, and business relapse led Alcoa to reduce the price of ingot to 18.8 cents 1913-14, but the sharp spurt of war demand in 1915 induced price increases of 5.8 cents in 1915, 10.8 cents in 1916, and 2.2 cents in 1917. The War Industries Board finally stabilized the price at 33 cents a pound, a figure double the production cost as reported to the Board by Arthur V. Davis, who was a member of the Board.[4]

POLICY IN THE 1920'S

Low tariffs after the war could have exposed the American aluminum market to world competitive influences, for capacity had been expanded in France, Germany, and other European sources, and foreign costs were lowered. At this time, however, the defeat of Wilson in 1920 had turned the government over to a group not strongly disposed towards interference with large-scale American business. This trend was epitomized in Harding's appointment of Andrew W. Mellon, largest stockholder in Alcoa and heaviest contributor to the Republican Party in 1920, as Secretary of the Treasury. Mellon took office in 1921, and remained in office until 1932, when he was appointed Ambassador to England. The 1922 Fordney-McCumber tariff, the towering apex of American tariff protection up to that time, included new high rates on aluminum. Their importance is shown by the fact that aluminum imports in 1921, while the low Underwood tariff was still in effect, had been equal to half of Alcoa's output. Shortly after the new tariff was enacted, Alcoa raised its prices by six cents.[5]

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[4] 74th Congress, 1st Session, Senate Committee Print No. 4, *Minutes of the War Industries Board, August 1, 1917–December 19, 1918* (Printed for the Use of the Special Committee Investigating the Munitions Industry), Washington, 1935, p. 184.

[5] Donald H. Wallace, *Market Control in the Aluminum Industry*, Cambridge, 1937, pp. 312, 238-41.

THE FAILURE OF ANTI-TRUST ACTION

Numerous attempts to reach Alcoa's monopoly power through the Federal Trade Commission (FTC) proved abortive in the 1920's. The FTC in 1919 forced Alcoa to divest itself of stock in the Aluminum Rolling Mill Company, in an effort to prevent Alcoa domination of the sheet rolling business. Soon after, the rolling mill suffered financial difficulties, and Alcoa bought up control. Its purchase was sustained by the courts.[6]

In 1922 the FTC and the Department of Justice investigated the purchase by Alcoa of control in the castings firm, Aluminum Manufactures, Inc., but no action was taken. In 1921 the Senate ordered the FTC to investigate the house furnishings industries. This led to an FTC report in 1924, which stated that Alcoa controlled the domestic price of sheet aluminum sold to cooking utensil manufacturers, and was violating the injunctions of the 1912 consent decree, which had forbidden discrimination against competitors.[7] Another FTC complaint was filed on July 21, 1925. It urged that a cease and desist order be issued, preventing Alcoa from (1) boosting scrap prices, (2) striving to monopolize sand castings, (3) making contracts and agreements in restraint of commerce in aluminum, (4) obstructing competitors who sought to buy aluminum on the open market. Even more comprehensive charges against Alcoa were offered for action by the FTC counsel in 1928, but were excluded from the case by the FTC, in order to avoid protracted hearings. Finally, the FTC dismissed the entire complaint, without explanation, on April 7, 1930.[8]

Harlan Stone, as Attorney General, announced his intention in 1924 of investigating Alcoa with an eye to prosecution, but this was not done; not long after, Stone left his post to become a Supreme Court Justice. At the end of 1925, the Department of Justice absolved Alcoa of violating the anti-trust laws and said the 1912 decree was sufficient to prevent monopoly control. Another investigation was requested by the Senate Committee on the Judiciary, after it had inquired into the perfunctory study which the Department of Justice had made.[9] This was voted down by the Senate.

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[6] *New York Times,* April 24, 1937.

[7] Harvey O'Connor, *Mellon's Millions,* New York, 1933, p. 162, quoting Federal Trade Commission, *House Furnishings Industry,* Chapter IV, Aluminum Cooking Utensils, Washington, D. C., 1925.

[8] O'Connor, *op. cit.,* pp. 176-82.

MILITANT ANTI-TRUST

Just as the anti-monopoly policy of 1913 had followed a change of administration in Washington, bringing about the only serious departure from the high tariff policy under which Alcoa had flourished, so the political changes in the 1930's finally gave rise to a militant anti-monopoly policy. In the period of the National Recovery Administration (1933-35), Alcoa and the independent fabricators had fought an inconclusive battle on the issue of discrimination.[10]

The second term of Franklin D. Roosevelt marked a real change in the Department of Justice and a new emphasis on anti-trust. Whereas there had been only 15 lawyers in the Anti-Trust Division in 1933, the staff was increased to 50 in 1938 and to 200 in 1939 (the 1939 appropriation being the largest in the history of the Division).[11] In 1933 the Department of

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[9] "The chief economist, assistant chief economist and assistant chief counsel of the Federal Trade Commission...testified [before the Senate Committee on the Judiciary] that a competent examination of their files on aluminum would take from one to four months. [Field Examiner] Dunn had spent ten days. They testified that the examination should be made by a person trained in both law and economics. Dunn was innocent of either qualification." *Ibid.*, p. 175.

[10] Equity No. 85-73. Brief for the United States, pp. 568-73. Certain independents had complained that Alcoa was maintaining monopolistic prices, was dominating the trade association set up to draft and execute the NRA Code, and was underselling them by manipulating the spread between prices of ingot and of fabricated goods. Wallace, *op. cit.*, p. 478.

[11] Thurman W. Arnold, *Bottlenecks of Business*, New York, 1940, pp. 70, 276.

Justice had begun to investigate Alcoa, after complaints from sheet rollers about the monopoly's price discrimination.

As a result of the investigation, the United States filed suit against Alcoa on April 23, 1937, in New York, naming as defendants Alcoa, 28 subsidiaries and affiliates, and 38 officers, directors, and stockholders. On petition of Alcoa, Judge Gibson of the Pittsburgh District Court declared that this suit would merely duplicate that of 1912, and issued an order restraining the Government from proceeding in New York with the new suit. After litigation, the Supreme Court on December 6, 1937, granted the United States permission to proceed in New York.[12]

This decision was in accord with the argument of the Department of Justice that the 1937 suit was broader and more fundamental than the 1912 action. In 1912 the legality of Alcoa's monopoly power had not been questioned. Instead, the Government challenged and enjoined certain means of maintaining the monopoly — restrictive covenants in bauxite and aluminum products, and international agreements. Now the monopoly power itself, including the power to control prices, passed under review, and broader remedies were demanded—dissolution of Alcoa, and divorce of Alcoa and Aluminium Limited. The charges against Alcoa in the 1937 petition were chiefly related to developments after 1912. Since that time Alcoa's enormous expansion and integration had placed the company in a new position of dominance.[13]

After the longest court trial on record (two years and two months, ending March 12, 1941), a trial in which 155 witnesses were heard and a record of 58,000 pages was amassed, Justice

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[12] Aluminum Co. of America v. United States, 302 U. S. 230, 1937, Docket No. 281, October Term, 1937.

[13] *New York Times*, June 8, 1937, December 7, 1937. The Department of Justice in 1937 contended that a business merely by being a monopoly was violating the Sherman Act; it made separate and independent contentions as to the illegality of acts leading to the monopoly. In making the final decision in 1945, the appeals court considered it important that Alcoa had actively excluded competitors. (See below, p. 246.)

Francis Caffey delivered his decision, the longest oral decision known, rejecting the Government's charges against Alcoa.[14] The Department of Justice filed its petition for appeal to the Supreme Court on September 14, 1942. But several members of the Supreme Court disqualified themselves, probably because of previous connections with legal actions affecting the aluminum industry. Action to expedite an appeal was delayed, possibly at the request of war agencies, which felt that war production would be impeded by anti-trust action. Finally, a special act of Congress, passed June 9, 1944, conferred jurisdiction on an appeals court consisting of the three senior circuit judges of the Circuit Court of Appeals in the circuit in which the district of the original trial was located.[15]

In the appeal, presented in January, 1945, the Government asked for effective relief through 5 measures which, it claimed, would not harm war production:

1) Within 90 days after the ending of hostilities, the parties should submit plans for the dissolution of the monopoly into several integrated companies.

2) Alcoa should be enjoined from acquiring, or continuing to control, leased DPC plants, or competitors' plants, after the emergency was over and leases then in force expired. The weak position of Alcoa's competitors, Reynolds and Olin, made doubtful their independent survival without subservience to Alcoa's price and production policies. Olin was completely, and Reynolds partly, dependent on Alcoa for alumina; Reynolds' fabricating plants were dependent on Alcoa for a large quantity of ingot. Thus, the Government argued, definite steps must be taken to prevent Alcoa from merely swallowing them up.

3) The common ownership of stock in Alcoa and Alted should be ended. This could be done immediately without harm to the war effort. The companies and their personnel should be enjoined from acquiring interests in each other, and from

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[14] 44 Fed. Supp. 97.

[15] Public Law No. 332, 78th Congress, 2nd Session.

making agreements fixing prices, restricting production, or dividing markets in the United States.

4) The combination between Alcoa and Aluminum Goods Manufacturing Company, maker of cooking utensils, should be dissolved by enjoining stock ownership in the latter by Alcoa and its personnel, and by enjoining any market agreements between the companies.

5) Interlocking directorates of the defendants in alumina, aluminum, bauxite, or power production, except as between parents and subsidiaries, should be enjoined.

6) The "price squeeze" should be enjoined immediately; that is, Alcoa should be prevented from selling fabricated products below its cost of fabrication plus the market price of the aluminum ingot used. This would protect the fabricating competitors of Alcoa after the war. (Alcoa had abandoned the squeeze in 1933, under the pressure of anti-trust suits, complaints by sheet rollers, and investigation by the Department of Justice.)

7) The 1912 decree should be supplemented by preventing Alcoa from making arrangements with any other party (specifically, Alted) to enter into international agreements on Alcoa's behalf.

8) Alcoa should be required to grant to any applicants, at reasonable royalties, licenses under aluminum production and fabrication patents, but only until the consequences of Alcoa's monopolistic practices had been dissipated. This would refer most definitely to aluminum pistons.

These relief measures were essentially a more explicit statement of the measures requested by the Government in the original trial in the lower court.

THE APPEALS COURT DECIDES

The special appeals court handed down its decision on March 12, 1945.[16] In determining whether Alcoa had a monopoly of virgin aluminum, the court had first to decide whether to include virgin aluminum which was produced by Alcoa and was put into products fabricated by Alcoa subsidiaries (and therefore not sold in the unfinished state), in the total of virgin aluminum production. If this metal were excluded, the proportion of virgin aluminum production controlled by Alcoa would be smaller. The court ruled, adversely to Alcoa, that Alcoa aluminum used by Alcoa subsidiaries should be included. The court also decided that the competition of secondary aluminum (which came in part from non-Alcoa smelters) should be disregarded in appraising Alcoa's control; and this ruling, too, was adverse to Alcoa. Thus the court was able to reach the finding that Alcoa controlled, before the war, 90% of the virgin aluminum supply. The fact that the remaining 10% of the aluminum supply came from overseas and not from domestic competitors is not relevant to the issue of monopoly, said the court; 90% control was sufficient to establish the existence of monopoly.

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[16] U. S. v. Aluminum Co. of America et al., 148 Fed. (2) 416 (1945).

Nor is it relevant to the discussion of Alcoa's legality, said the court, that Alcoa's profits on invested capital, over the fifty years of its life, averaged only about 10%. For, although the figure is not "extortionate" in view of the risk of changing demands, of obsolescence of methods, and of potential substitutes, and in view of the dependence of the industry on tariff protection, the profit on ingot was not necessarily the same as the profit on the whole of Alcoa's business, and we have no means of allocating a proper share of profit to ingot. The plaintiff does not even have to prove that an immoderate profit was received. Monopoly is not condemned because it has not been used to get undue profits from consumers. For in the opinion of many, prices can be brought down by cost reductions under the spur of competition, which encourages initiative and invention. Fair profits can conceivably be made at lower prices.

Moreover, the efficiency and ingenuity of a monopoly are not a defense, for Congress forbade not merely "bad" trusts but all trusts; in so doing, it was actuated by the desire to preserve a system of self-reliant small producers for social or moral, rather than for economic, reasons. In the light of this reasoning, Alcoa's monopoly of ingot was deemed to be of the kind covered by Section 2 of the Sherman Act.

The question of origin of a monopoly may be critical in determining its legality, since a company may unwittingly have a monopoly thrust upon it. Alcoa, however, was not found to be the passive beneficiary of a monopoly.

> " Already, in 1909, when its last lawful monopoly ended, it sought to strengthen its position by unlawful practices, and these concededly continued until 1912."

Between 1912 and 1934 Alcoa expanded its two ingot plants in New York, added three new ones, and increased production almost eight-fold, while no one else produced a pound of ingot.

> "This continued and undisturbed control did not fall undesigned into 'Alcoa's' lap . . . it could have only resulted . . . from a persistent determination to maintain the control with which it found itself vested in 1912. There were at least one or two abortive attempts to enter the industry, but 'Alcoa' effectively anticipated and forestalled all competition, and succeeded in holding the field alone."

It effectively excluded competitors by progressively embracing each new opportunity as it opened, and by facing " every newcomer with new capacity already geared into a great organization, having the advantage of experience, trade connections and the elite of personnel." Only if exclusion is narrowly interpreted to cover only "manoeuvres not honestly industrial, but actuated solely by a desire to prevent competition " could Alcoa's course of action " be deemed not 'exclusionary'. So to limit it would in our judgment emasculate the [Sherman] Act." It is true that Alcoa aided competitors, but these were fabricators, and " we can find no instance of its helping prospective ingot manufacturers."

After this broad reversal of the general conclusions of the lower court, the appellate court adhered closely to the findings of the lower court on the alleged illegality of specific practices of Alcoa. In most cases it ruled that Alcoa's acquisition of raw materials, power, and fabricating outlets could conceivably have had other motives besides excluding competition. The one practice adjudged to be illegal was the price squeeze in sheet, and resumption of this was to be enjoined. As Alcoa had been deemed a monopoly in the meaning of Section 2 of the Sherman Act, the support of the District Court findings on most of the specific practices was not overly important for future policy; for it was not necessary to prove that each practice was a combination, contract, or conspiracy in restraint of trade in the meaning of Section 1 of the Act in order to take action against Alcoa.

On the alleged participation of Alcoa through Alted in the Alliance cartel, and on the alleged illegality of the cartel itself, the court took a split position. It did not support the government's charges that Alcoa was in agreement, or unduly close relations, with Alted, and that Alcoa was in effect a party to the Alliance, and refused to require that stockholders in Alcoa and Alted be divested of stock in one or the other company. But it ruled that the 1936 Alliance agreement was intended to, and did, affect imports into the United States, and that the influence of the Alliance on the aluminum supply here indirectly, but illegally, affected American prices. Therefore the court specifically enjoined Alted from entering into any cartel covering imports into the United States, and it ruled that the Alliance was formally alive, although inactive. Alted had previously accepted the jurisdiction of the American courts after unsuccessfully trying to win a court ruling that it was outside American jurisdiction. Violation of the injunction would jeopardize the doing of business by Alted in this country, and the personal freedom of its officials when in the United States.

WHAT TO DO ABOUT IT?

The practical question facing the court, once it had decided that Alcoa was a monopoly, was what to do about it. The court stated that owing to the economic changes brought by the war (especially the building of DPC plants), Alcoa's postwar position was unpredictable until the disposal of government-owned plants had determined future ownership patterns. Dissolution of Alcoa might not turn out to be a proper remedy after all.

> Dissolution is not a penalty but a remedy; if the industry will not need it for its protection, it will be a disservice to break up an aggregate which has for so long demonstrated its efficiency.[17]

The court in effect set up the Surplus Property Board, or its agency, as a specialized tribunal to create a comprehensive design for the aluminum industry. This was consistent with the Surplus Property Act of 1944, which authorized the Surplus Property Board to designate agencies for the disposal of DPC aluminum plants on any terms deemed proper by the agency. The objectives which were to guide disposal, under this act, included aid to the re-establishment and development of " free independent private enterprise ", discouragement of monopoly practices, and a policy of preference and financial assistance to smaller purchasers. The District Court, to which the case was referred for future action, was to wait until the government properties had been disposed of before deciding whether dissolution was necessary.

The government's charges against Aluminum Goods Manufacturing Company were rejected. No action was taken on the proposals that Alcoa be required to issue licenses under its patents, or that various interlocking directorates be enjoined.

The decision had the practical purpose of exposing Alcoa to both domestic and foreign competition after the war. The former was to be achieved by dissolution unless DPC plants passed to viable competitors. The latter was promised by precluding the formation of a world aluminum cartel, which could not exist without Alted. While foreign aluminum could be warded off to some degree by a tariff, expanded capacity abroad would lead to imports despite a tariff (if one judges by the past history of the industry) unless Alcoa kept its prices low. Competition, or fear of competition, would mean low aluminum prices reflecting consumer gains from progress in the industry. As Alcoa's strength was to be reduced either by dissolution or by the use of DPC plants to build up competitors, it would be more difficult for informal cartel relations to develop, since some control of the domestic market is essential for the success of an international cartel.

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[17] *Ibid.*, p. 1253.

Dissolution of the Alliance, an international organization including German and pro-German Swiss concerns, will contribute politically as well as economically to the peace and dignity of the United States. For a Nazi war machine will not have a postwar footing in the form of world market rights recognized by American and other businesses.

OTHER REMEDIES NEEDED

The history of the aluminum monopoly shows the use of many varied devices to build and preserve power: holding companies, mergers, leases, patent agreements, purchase contracts, community of stockholders, directors, and officers, cartel membership, price discrimination, etc. The vocabulary of control forms has not yet been exhausted. Under favorable circumstances new ways of stabilizing market power may emerge in the postwar aluminum industry.

Some remedies for the effects of monopoly power, which supplement the court's recommendations, can be adopted regardless of the form of organization which finally develops in the aluminum industry. Restrictive tendencies of industrial groupings are encouraged by the desire to protect members against possible adverse effects of demand changes. These changes may be due to a shift of demand from one product to another (substitution), seasonal variations in purchase of one product, variations in people's expenditure on all kinds of goods (the national income) commonly associated with the business cycle, or other causes. Some special market problems of the growing aluminum industry are described on pp. 117-8. While various types of changes have been felt in the aluminum market, the most serious in effect have been reductions in demand accompanying general business depressions, and, particularly, the depression of the 1930's.

In view of the worldwide aluminum market, unstable economic conditions in any important country would have some international repercussions in the industry. Contraction of income in any supplying country might lead to dumping to get rid of surpluses, to counter-measures of industrial warfare, and very likely to new secret or tacit control agreements. Contraction in any consuming country would leave suppliers fighting for domination of a shrinking world market. Sharp and temporary booms are almost as dangerous as slumps, for induced expansions of capacity may weight down the market even more in the next crisis, and lead to new restrictive measures. For example, the tightest international control mechanism developed in the aluminum industry, the Alliance cartel, was introduced in a great depression following two waves of expansion in world capacity—during the war, and in the 1920's. The pressure of excess capacity and the weight of overhead costs in this large-scale, integrated industry would make it very difficult to keep producers apart by legal action, if the market should be uncertain and declining.

If it were possible to mitigate or avert sharp changes of great degree in national incomes, a better environment would exist for capacity production of aluminum. This goal could be more easily achieved, either because of producers' more stable outlook on future markets, or because of public activity in opposition to restrictive policies, which producers would be less able to defend on grounds of necessity. Also, new competitors would have an improved life expectancy in stable market conditions. It is clear that any measures adopted for income stabilization would not only have to be part of a carefully thought out national policy, but would involve harmonious action of other nations working towards the same goal. All that can be done in this study is to point out the need for overall action toward this goal.

TOWARDS AN ACTIVE WORLD MARKET

Big reductions in the tariff on all aluminum products (leading to abolition) will destroy one specific protection which Congress has provided to the aluminum monopoly. Tariff reduction may lower prices, broaden the market for aluminum, and remove a bargaining aid in cartel dealings. (The partial protection of the domestic market which the tariff supplies makes industrialists bolder in demanding larger shares in the world market.) Politically, it is hard to eliminate a tariff in a depression, as workers and other groups are fearful of worsening conditions of unemployment. Therefore the achievement of tariff cuts may depend on the maintenance of full employment.

Direct subsidies and credits should be made available to potential competitors of Alcoa in order to supplement tariff reduction in restoring a more active world market in aluminum. Cheap lease or sale of the DPC plants is the first step. Cheap supply of power would be desirable. Financial aid should be granted: (1) to new methods of producing alumina from inferior clays; (2) to new methods of making magnesium, e. g., the carbothermic methods described in Chapter VII (Both (1) and (2) would be desirable for national defense because of the limited domestic supply of high grade bauxite); (3) to backward nations rich in the needed raw materials, for the development of light metals industries adapted to their potential home needs and to future export markets. It would be be desirable to grant aid to backward countries in the form of loans, since investments in such projects can be self-liquidating. The model of the International Bank for Reconstruction and Development proposed at Bretton Woods in 1944 is a good one. Where international subsidy of power production, for the service of areas like the Danube countries, can greatly hasten their economic growth, the direct grant or very-long-term, very-low-rate loan might be appropriate.

COMPETITION BY SUBSTITUTES

The development of magnesium can be guaranteed more effectively if Alcoa and any other aluminum producers are separated from the magnesium business. The integration in production of aluminum and magnesium is not close enough to make them joint products. (See Chapter VII.) Therefore, few production economies would be sacrificed to the cause of independent marketing of these substitute materials. The 1942 consent decree in magnesium, while cancelling patent licenses in magnesium received from the Magnesium Development Company, did not divorce Alcoa's subsidiary, American Magnesium Corporation (in which I. G. Farben had once been granted a half interest), from Alcoa. Nor did the decree impose restrictions on production of magnesium, or fabrication of magnesium products, by Alcoa. Measures to insure a permanent divorcement should be framed carefully enough to cover all other materials not technologically integrated with aluminum production at some important stage. Cancellation of patents not used by the owner or licensed in return for a reasonable royalty, would be necessary to prevent monopolistic restrictions on development of light materials industries. Licenses should not limit quantities produced, purposes for which patented processes are used, or areas in which licensees may sell. (A bill introduced by Senator O'Mahoney on April 28, 1942—S.2491—contained provisions covering these points.)

If potential competition to the aluminum monopoly is to be strengthened by government action, it will be necessary to persuade the Canadian government to take parallel action affecting Alted, and not to permit Alted's present position of expanding market power to remain unchallenged.

ALTERNATIVE TYPES OF ORGANIZATION

The measures which have been suggested are mutually compatible, and as a group are compatible with private monopoly, oligopoly, or government ownership in the aluminum industry. The form of organization is not in itself the determinant of whether or not competition will exist, although certain forms will be more conducive to competition than others. The basic criterion to be used in deciding which form is preferable is the social performance of the aluminum industry, measured in terms of steady provision of cheap, plentiful aluminum and ample employment.

WHAT DISSOLUTION MEANS

The court has ruled that the aluminum monopoly shall be dissolved unless the DPC plants go to competitors. In either case, oligopoly (a market where there are only a few large sellers) would result. It is possible that steady competition will not be promoted, but that communities of interest will develop (as in the steel and rubber industries), with tacit or secret agreement as to market policy. If one firm stands out in size, it might become the price leader of the others. Price discrimination might persist, especially if the companies were of unequal strength in particular fabricating fields, or if one competitor had to rely on another for bauxite, alumina, ingot, or sales outlets for aluminum manufactures. On the other hand, rivalry among the firms is possible. There is no necessary technical or economic reason why aluminum production should be carried on by one firm rather than by several large integrated ones.

It seems unlikely, however, that without the stabilization of general demand, the maintenance of an active world market, and direct measures to control the performance of the aluminum industry, oligopoly alone would guarantee full utilization of investment and manpower. For with any slump in general demand, the existence of excess capacity would threaten intolerable price warfare (since price, in the short run, would not have to cover overhead costs), and would destroy stable competitive conditions. Then combination would be highly probable. This analysis runs parallel to the previous discussion (p. 250) of the world market; there the actions of world oligopolists were considered, while here oligopoly in a single national market is found to obey similar economic pressures.

REGIONAL BALANCE

Dissolution or distribution of DPC plants might have the advantage of improving the regional representation and regional autonomy in the industry. An independent Pacific Coast firm, for instance, would cling tenaciously to a productive level if shutdowns would destroy its economic existence. But a national monopoly might cut back Northwestern production, maintaining output levels elsewhere, but hurting employment badly in a concentrated area. Regional balance might also be encouraged if removal of the monopoly attracts newcomers into the industry. It was reported that Reynolds Metals Company has proposed a new Northwestern aluminum company cooperatively owned by important aluminum consumers (the automobile, airplane, and railway-equipment companies). This might widen uses of aluminum in transportation, since the fear of dependence on a monopoly source of supply would be destroyed. Employment in the Bonneville area, where Alcoa is the largest user of electricity, would no longer depend on the single firm's policies.[18] Use of DPC facilities in the Northwest would aid this project.

Dissolution would reveal inefficiencies in the present integration of the industry, which includes in one ownership certain poorly related geographical areas. Certain parts of a former Alcoa might become obsolescent and leave the industry or reorganize if they had to stand on their own corporate feet and show operating profits.

A second approach to the question of organization in the industry looks toward government ownership of the plant facilities used directly and indirectly to make aluminum. This would involve retention of all DPC facilities, contrary to present plans for complete liquidation of surplus properties by private sale. If carried through to the point of government monopoly, it would also involve nationalization of the properties of Alcoa—a step theoretically justifiable on the grounds of the wartime importance of aluminum. The government already owns another important sector of the aluminum production capacity viewed as a whole—Federal power facilities. Aluminum production in the South and in the West is at least partially dependent on energy from Government projects such as TVA and Bonneville.

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[18] A. G. Mezerik, "Journey in America: VI", *The New Republic*, December 25, 1944.

The government has the choice of several possible methods of utilizing aluminum facilities. It could employ workers and managers to operate all facilities for the production of virgin aluminum. This would include power generators, aluminum plants, aluminum reduction plants—possibly bauxite mining. The virgin aluminum would be sold to fabricators. It would probably be unnecessary and unwise to take over fabrication as a government industry, if prices are kept down, for production of finished aluminum goods is on a smaller scale than reduction of ingot, and is already partly integrated with aviation and other industries. Government operation could stimulate use of aluminum in industry, much as government production of power stimulates industrial consumption of electricity. It would eliminate the division of the formation and execution of policy found in regulated public utilities. Presumably no incentive to restrict output would animate a government aluminum industry. Adequate active capacity for national defense could be guaranteed.

As an alternative, the government could become a competitor with private aluminum production through the setting up of an integrated firm. As the industry has a large potential market, expansion of both public and private investment in aluminum capacity is quite likely. The idea of a government competitor could be joined with that of dissolution of Alcoa or subsidization of new private firms to insure the industry against new formations of monopoly patterns. The industry might assume the aspect of oligopoly in which "workable competition" among the firms existed. (See Chapter I.) It would differ from the model of "workable competition" set up by J. M. Clark only in that at least one firm is owned by the government rather than by private entrepreneurs. This would be feasible whether or not Alcoa is dissolved.

If it seemed desirable to expand the sphere of regulation and contract the sphere of direct government competition, compromises are possible. The government could operate power and alumina facilities and sell both essential components to aluminum smelters. In this case, as in that of sale of virgin aluminum to fabricators, some sort of price control would be desirable to insure full utilization of aluminum supplies. Or the government might lease or sell the alumina and aluminum plants to private operators, under terms stipulating a percentage of capacity at or near which operations should be maintained.

CONTROLLING ALUMINUM PRICES

Price control would be useful under any form of ownership, for sufficiently low prices would stimulate use of the metal (if the demand is assumed to be elastic) and permit full production.

It might be argued that, once the sale or lease of properties has taken place, or once the alumina, power, or ingot has been sold to the industrial user, the government ought to refrain from direct control of prices and frame a more general approach which would imply less "interference" with industry. Often cited is an excess profits tax to remove the incentive to restrict production and charge higher prices. But total profits could be quite moderate if the prices were increased at the sacrifice of production volume. If profits per pound were taxed to make an excess profits tax more effective, the government might just as well control the price without further ado. For the accounting controls would be very similar in both cases, and the advantage of wider use of aluminum would be guaranteed by a price ceiling as it would not be if industry retained the power to keep the price high and pay the tax. A tax on excess capacity might also be used to destroy restriction.

Possibly any one of the industrial forms just described would be workable in conditions of full employment, an active world market, and a dynamic technology. Therefore, it would be wise to stress those measures, suggested in the first group of policy proposals, which can foster expansion of production and markets. There will be more disagreement on the extent of government ownership and operation, direct regulation, the degree of basic integration to be preserved, and other questions just considered. For the immediate future, practical programs should focus on the measures around which as many people as possible can unite, and should provide them with standards of action which can be widely understood and widely supported. The indirect approach to the aluminum monopoly will probably meet this need best.

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